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Getting the Most Out of Your Machine Tool Dollar

By W. S. Graham
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"Thanks to the initiative of the machine tool builders most production equipment in automobile plants becomes obsolete long before it wears out." . . . "The function of the purchasing agent, so far as production equipment is concerned, is to issue confirming orders after the production people have decided what they want. The equipment salesmen must, therefore, talk with production engineers and they must talk shop language"

STYLE changes are generally considered to be the pet problem of the manufacturers of shoes and clothing but they are also of considerable moment to the automobile manufacturer. Two recent examples will illustrate the point: four-wheel brakes and balloon tires. Both of them necessitated drastic chassis changes and made life miserable for the production department while the changes were in progress.

Such contingencies put restrictions on the serviceable life of the production equipment in the automobile plant that do not ordinarily obtain in other machine building establishments. They are responsible for the insistence by automotive production engineers that machine tools purchased on their recommendation pay for themselves in a relatively short space of time.

It is our practice in the Hupp plant to require a new machine to earn its cost in one year, or at the most eighteen months. If we cannot secure a machine that will meet this demand we try to perform the operation for which a new tool is to be bought in some other way. Often the redesign of a fixture will show the way out. If not it may be necessary to alter the part to make it better suited to existing machine equipment.

We will go to quite some trouble to achieve this result as we are extremely averse to installing single-purpose tools. In fact, we consider them only as a last resort and when we are forced to put them in we insist that they pay for themselves during a standard run of 10,000 to 15,000 cars. The reason is obvious. The production department must build what the engineering department designs and there may well be more or less drastic changes when a new series comes along, changes that will make some of the old equipment useless. Machines of this type should, in our opinion, show really spectacular increases in performance over standard tools. Otherwise there is no excuse for their existence.

Where it is possible we like to have special machines built so that there is a certain amount of flexibility or adjustment even though the cost may be somewhat greater. We prefer, for instance, to have multiple spindle drills provided with adjustable rather than fixed spindles so that they can still be used if slight changes in the location of drilled holes have to be made.

It is against our policy to build special machines in our own shops. We have all we can do to design and build automobiles although of course we have ideas as to how machine tools ought to be built. Most users have. Our ideas are influenced by our experiences with machine tool troubles. Most of the troubles can be traced back to insufficient lubrication although some of the bearings used even in standard machines are practically impossible to lubricate. They would not be used in fixtures in the Hupp shops.

Another important cause of machine failures is carelessness, a trait that some few American mechanics seem to consider one of their inalienable rights. It is a question whether it is worth while, or even possible to design production equipment that is foolproof. What can you do with a man who insists on trying to shift the gears of an operating machine in spite of the fact that there is a large plate on the headstock warning him that it can't be done?

The fact that almost every shop group will include one or more individuals with a queer psychological twist makes it imperative to be sure that new equipment that fails to produce according to guaranty has had a fair chance to do so. We almost threw out one big machine under such circumstances. Careful study, however,

proved that the fault was not with the machine but with the lack of teamwork in the gang operating it. As soon as a fair degree of teamwork had been built up the machine exceeded its guaranteed output.

Thanks to the initiative of the machine tool builders most production equipment in automobile plants becomes obsolete long before it wears out. Machine tools wear out very slowly in any shop if they are properly lubricated. What to do with such equipment is a constantly recurring problem for the works manager to solve. Generally speaking, the policy in the Hupp plants is to have the newest tools in the production line, those that have done duty there being transferred to less important work.

The way replacements work out is often something like this: A department foreman discovers from the monthly repair expense report on the machines under his supervision that one machine is costing entirely too much. He gets these figures from the machine repair department. Careful records are then kept on this machine to determine whether it should be replaced or rebuilt. These records are kept for the troublesome machines only.

If the machine foreman and the department foreman agree that replacement is necessary, and are able to convince the tool supervisor, a conference with the division superintendent decides the matter. The department foreman can suggest what tool he wants for the replacement. The tool supervisor issues a requisition which passes in turn through the hands of the division superintendent, general superintendent, and works manager. The purchasing agent issues the confirming order to the supplier.

When the new machine arrives and is installed, the old one is generally used for some other purpose where the requirements are not so severe, or else is disposed of.

New Machines for Production

Another situation that results in the purchase of new equipment is the introduction of new operations. If there is some doubt as to the permanency of the new method it is customary to take some standard machine from the production line for it and replace this machine with a new one that will in all probability be a better performer. For instance, in one department drilling and tapping operations were performed on separate machines because the drill had no tapping attachment. When a new drilling job turned up in another department, this drill was assigned to it and a new drill with a tapping attachment was purchased for the first department. Thus, again, the newer equipment is used for the vital operations while the older tools are relegated to less important tasks.

Repair parts for production equipment are made in our own shop, when materials of better quality are needed. Better service is obtained from some machine tools by substituting steel for cast-iron gears. Others are improved by installing alloy steel gears to replace the ones made of carbon steel. In cases where substitution of parts have been made, and when such changes have proven effective by decreasing cost upkeep, prolonging the life of the machine, and increasing the output, we take steps to notify the tool manufacturer of these changes so that they will benefit by our experience. The cost of repair parts is a minor factor with us, because we can usually buy service parts cheaper and they are available more quickly than if we have to make them.

The problem of whether to rebuild or replace can sometimes be solved by looking at it this way. Suppose a milling machine has reached the stage where something has to be done with it. On the books it has been depreciated until its value is only nominal. It will cost, say, seven hundred and fifty dollars to put it in first-class condition. Now suppose that instead of being one of our worn-out machines this tool was in the surplus store of another automobile company, available at the same nominal price as that shown on our books. Would we buy it and spend seven hundred and fifty on it?

The chances are that we would not consider anything of the sort. Why, therefore, should we rebuild one of our own old machines at the same expense and with the same result?

In conclusion, a word about machine tool salesmen may not be out of place. As stated earlier in this article the function of the purchasing agent, so far as production equipment is concerned, is to issue confirming orders after the production department people have decided what they want. The equipment salesmen must, therefore, talk with the production engineers and they must talk shop language. As a rule they can and do, and their visits are welcome.

Where Some Salesmen Fail

There are exceptions, however, and they are exasperating. Here is a case: In talking over details of a new machine with a salesman he was asked the dimensions of a particular part. He hemmed and hawed and finally admitted he would have to ask the factory, thus holding up proceedings for several days. Why did we want details on this one point? Because our experience with other machines of the same general type indicated that weakness at this point was common to all of them. We were anxious to learn whether the manufacturer of the machine in question had realized the existence of weakness here and if so what steps he had taken to eliminate it. A first-class salesman would have known of the weakness and how it had been taken care of in the machine he wanted to sell.

[The preceding article is the sixteenth under the title, "Getting the Most Out of Your Machine Tool Dollar." The first article, by J. A. Smith, General Superintendent of the General Electric Co., Schenectady, N. Y., was published on page 409, Vol. 62. The second, by C. A. Shaffer, General Supervisor of Machinery and Tools of the Illinois Central Railroad, was published on page 521, Vol. 62. The third, by Robert F. Runge, Vice-president of SKF Industries, Inc., was published on page 719, Vol. 62. The fourth, by L. C. Morrow, Managing Editor, *American Machinist*, outlining the policies of the International Harvester Co., was published on page 793, Vol. 62. The fifth, by G. T. Christopher, Factory Manager, the Dayton Engineering Laboratories Co., was published on page 907, Vol. 62. The sixth, by D. C. Wright, of the H. W. Caldwell & Son Co. plant of the Link-Belt Co., was published on page 1, Vol. 63. The seventh, by T. C. Vail, superintendent, the Spicer Manufacturing Co., was published on page 175, Vol. 63. The eighth, by E. R. Norris, director of works equipment, the Westinghouse Electric and Manufacturing Co., was published on page 255, Vol. 63. The ninth, by Fred H. Colvin, Editor, *American Machinist*, was published on page 417, Vol. 63. The tenth, by Wm. Bailey, production manager, the Hoover Co., was published on page 917, Vol. 63. The eleventh, by G. S. McKee, assistant factory manager, the Timken Roller Bearing Co., was published on page 995, Vol. 63. The twelfth, by Wm. Hartman, superintendent, the National Cash Register Co., was published on page 1, Vol. 64. The thirteenth, by Percy S. Brown, works manager, the Corona Typewriter Co., Inc., was published on page 183, Vol. 64. The fourteenth, by M. H. Westbrook, shop superintendent, Grand Trunk Railway System, was published on page 261, Vol. 64. The fifteenth, by Jerome R. George, vice-president, Morgan Construction Co., was published on page 381, Vol. 64. Other articles on the same subject will be published in forthcoming issues.]

A foreman, if worthy of his position, is capable of doing constructive thought about his work. Regular foremen's meetings are wonderful stimulators of that kind of thought. A reward now and then for a valuable suggestion will help.

1925 Inventory of Machine Tools in the Class-I Railroad Shops

The total numbers of machine tools arranged alphabetically by name and in groups according to operation importance

HOW many lathes, how many grinders, how many, in fact, of each type of machine tool are at present in use in the Class-I railroad shops of the United States? How many in each of these types are ten years old or older?

The answers to these questions are listed here in two tables, the first to show the equipment in alphabetical order and the second to list the machines according to operation groups and to arrange these groups in order of their numerical importance.

The double columns of figures show, to the left, the total number of each type in service and, to the right, the number represented by the machines that were purchased and installed ten years or more ago.

How were these figures obtained?

On page 587, Vol. 64 of the *American Machinist* there was published a statistical analysis on this same subject, the types of equipment and their relative ages and importance. This analysis, as there stated, was based on the returns from a questionnaire sent out by the *American Machinist* to the executives of the Class-I steam railroads. The returns represented 30 per cent of the Class-I roads, and the count of machines was given by percentage, after analysis of these returns showed them as representative of the roads as a whole.

In order to make the total count, in figures, for all the roads, as shown in this article, it was necessary to find and apply a reliable basis for expanding the count, given on the questionnaire return, from its 30 per cent representation to 100 per cent. "Locomotive miles per day" was used for this purpose on the valid assumption that a locomotive requires repairs, on the average, after having been driven for some given number of miles.

The total of locomotive miles per day on all of the Class-I roads was calculated from the latest reports made by the Interstate Commerce Commission. The figure for locomotive miles per day as represented by the known roads, those from whom the questionnaire data had been received, was separated from this total, and divided into the total number of machines shown on the questionnaire.

This gave a proportion for machines per locomotive mile per day on the known roads. Then, by multiplying this proportion by the total figure for locomotive miles per day for all roads, the total of equipment was arrived at, and showed 66,380 machine tools for all types reported.

It is of interest that, while the questionnaire returns represented approximately 30 per cent of the Class-I

Table I—Equipment Grouped Alphabetically

Machine Name	Now in Service	Purchased Prior to 1915	Machine Name	Now in Service	Purchased Prior to 1915	Machine Name	Now in Service	Purchased Prior to 1915
Bending Brakes	284	135	Forging Machines Hot	624	466	Milling Machines Plain	386	267
Bending Rolls	907	734	Forging Machines All Other	195	133	Milling Machines Planer	132	77
Blanking Presses Power	153	81	Forming Presses Hydraulic	159	109	Milling Machines Universal	518	365
Boring Mills Horizontal	545	440	Forming Presses Power	32	9	Milling Machines Vertical	136	86
Boring Mills Vertical	2460	1510	Grinders Cutter	562	338	Milling Machines All Other	33	17
Buffers Belt Type	77	50	Grinders Cylindrical	642	450	Planers Openside	519	38
Buffers Wheel Type	150	133	Grinders Disk	231	159	Planers Standard	2521	1942
Buffers All Other	5	4	Grinders Internal	311	95	Punching Machines	737	529
Centering Machines	496	458	Grinders Stands	5620	3650	Punch and Shear Combined	1325	926
Cutting Off Friction Saws	209	117	Grinders Surface	444	226	Riveters Hydraulic	45	40
Cutting Off Hack Saws	665	348	Grinders All Other	210	172	Riveters Pneumatic	430	184
Cutting Off Cold Saws	351	223	Hammers Helve	235	163	Riveters All Other	15	10
Cutting Off All Other	27	2	Hammers Pneumatic	185	131	Shapers Horizontal	2790	1850
Cutting and Threading Bolt	2780	2030	Hammers Spring	108	72	Shapers Vertical	40	20
Cutting and Threading Pipe	1330	730	Hammers Steam	1750	1285	Shears Knife	812	560
Drills Radial	2090	1242	Hammers All Other	57	24	Shears Rotary	230	131
Drills Sensitive	1195	755	Keyseating Machines	100	88	Shears Slitting	212	122
Drills Upright	4100	3030	Lathes Axle	760	480	Shears All Other	31	21
Drills All Other	75	53	Lathes Engine	9940	7000	Slotters	876	664
Extruding Presses Hydraulic	704	351	Lathes Speed	285	276	Straightening Rolls	146	116
Forcing Presses Arbor	361	266	Lathes Toolroom	460	278	Welding Machines	1020	113
Forcing Presses Hydraulic	1048	308	Lathes Turret	2140	1442	Miscellaneous	5638	3095
Forcing Presses Power	580	371	Lathes Wheel	1220	808			
Forging Machines Bulldozer	481	432	Lathes All Other	445	312	**Grand Total**	**66380**	**43142**

Table II—Equipment Grouped by Operations

Machine Names in Operation Groups	Now in Service	Purchased Prior to 1915
Engine Lathes	9940	7000
Turret Lathes	2140	1442
Wheel Lathes	1220	808
Axle Lathes	760	480
Toolroom Lathes	460	278
Speed Lathes	285	276
All Other	445	312
Total Turning	**15250**	**10596**
Grinding Stands	5620	3650
Cylindrical Grinders	642	450
Cutter Grinders	562	338
Surface Grinders	444	226
Internal Grinders	311	95
Disk Grinders	231	159
All Other	210	172
Total Grinding	**8020**	**5090**
Upright Drills	4100	3030
Radial Drills	2090	1242
Sensitive Drills	1195	755
All Other	75	53
Total Drilling	**7460**	**5080**
Bolt Cut and Thread	2780	2030
Pipe Cut and Thread	1330	730
Total Cut and Thread	**4110**	**2760**
Horizontal Shapers	2790	1850
Slotting Machines	876	664
Vertical Shapers	40	240
Total Shape and Slot	**3706**	**2534**
Combination Machines	1325	926
Knife Shears	812	560
Punching Machines	737	529
Rotary Shears	230	131
Slitting Shears	212	122
All Other	31	21
Total Punch and Shear	**3347**	**2289**
Standard Planers	2521	1942
Open Side Planers	519	38
Total Planing	**3040**	**1980**
Vertical Boring Mills	2460	1510
Horizontal Boring Mills	545	440
Total Boring	**3005**	**1950**
Steam Hammers	1750	1285
Helve Hammers	235	163
Pneumatic Hammers	185	131
Spring Hammers	108	72
All Other	57	24
Total Hammering	**2335**	**1675**
Hydraulic Wheel Presses	1048	308
Power Wheel Presses	580	371
Hand Arbor Presses	361	266
Total Forcing	**1989**	**945**
Binding Rolls	907	734
Bending Brakes	284	135
Straightening Rolls	146	116
Total Bend and Straighten	**1337**	**985**
Hot Forging Machines	624	466
Bulldozers	481	432
All Other	195	133
Total Forging	**1300**	**1031**
Power Hacksaws	665	348
Rotary Cold Saws	351	223
Friction Saws	209	117
All Other	27	2
Total Cut-Off	**1252**	**690**
Universal Milling Machines	518	365
Plain Milling Machines	386	267
Vertical Milling Machines	136	86
Planer Milling Machines	132	77
All Other	33	17
Total Milling	**1205**	**812**
Welding Machines	1020	113
Total Welding	**1020**	**113**
Hydraulic Extruding Presses	704	351
Total Extruding	**704**	**351**
Centering Machines	496	458
Total Centering	**496**	**458**
Pneumatic Riveting Machines	430	184
Hydraulic Riveting Machines	45	40
All Other	15	10
Total Riveting	**490**	**234**
Power Blanking Presses	153	81
Hydraulic Forming Presses	159	109
Power Forming Presses	32	9
Total Blank and Form	**344**	**199**
Wheel Type Machines	150	133
Belt Type Machines	77	50
All Other	5	4
Total Buff and Polish	**232**	**187**
Keyseating Machines	100	88
Total Keyseating	**100**	**88**
All Other Machinery	5638	3095
Total Miscellaneous	**5638**	**3095**
Grand Totals	**66380**	**43142**

railroads, the locomotive miles per day on these same roads came to somewhat over 29.5 per cent of the total. The point shows the representative coverage of the completed questionnaires, and lends strength to the averages determined.

The problem of dividing this total of 66,380 machines into the individual types and the operation classifications was made simple by applying the figures from which the percentage charts were constructed for the article previously mentioned.

Thus, from the original charts, machine tools for turning, which represent 23 per cent of all railroad shop equipment, show a total installation of 15,250 units. Of this total, as the second percentage chart showed, 70 per cent, or 10,596 units have had ten or more years of service.

Further division of the operation groups was made by using the figures back of the third chart. Thus engine lathes, which represented a total of 65 per cent of all machine tools for turning, showed 9,940 units in service, turret lathes showed 2,140, wheel lathes 1,220, grinding stands 5,620, radial drills 2,090, and similarly down through the list.

What can the machine-tool builder determine from this analysis?

Here is one item among others, that of the average market for his product. Taking engine lathes for example. There are 9,940 now in service. Assume, in order to be conservative, that this number will not be increased by expansion of the shops and that 20 years is the average life. There is a yearly demand for engine lathes of the total number divided by 20, or 497 of all makes that will be needed to supply the demand without reference to present replacement requirements for machines over the age limit but still in use.

Reason vs. Threats

By G. B. Stewart

Going through a plant recently I noticed a big sign to the effect that a workman caught smoking within the premises was "subject to immediate discharge." Before I was there long I saw another rather strongly worded notice, and began to wonder what kind of discipline and co-operation existed in that shop.

It seems to me that in these days, when the average mechanic has a fair education, owns his own automobile, and knows something of politics from prohibition to world courts, it is poor policy not to give him an even break on shop rules. If there is anything that is likely to make a man resentful it is to hold a threatening club over him, and any management that has to resort to threats to have its rules enforced is in a precarious position. A modest sign "Insurance rules prohibit smoking," is likely to get more cheerful response from employees than a dozen threatening signs.

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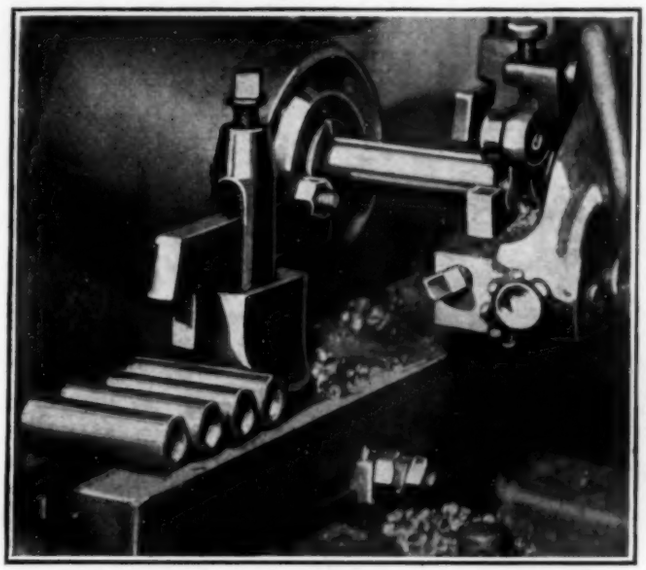

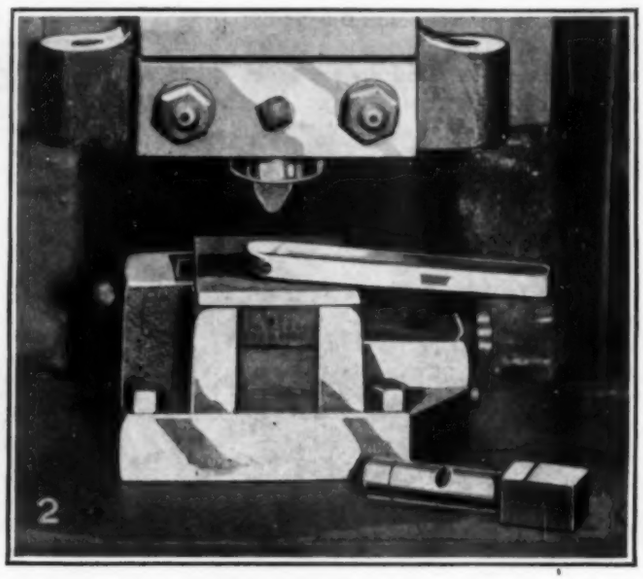

Fig. 1—Turning and cutting off pins. Fig. 2—Grooving in punch press

Piston-Pin Methods That Are Different

By Fred H. Colvin
Editor, *American Machinist*

How Rickenbacker utilizes steel tubing for piston pins, and punches the groove for the binding bolt—Grinding on a mandrel with special backrest

THE Rickenbacker method of making piston pins includes several operations that are of special interest. The pins are made from steel tubing of the desired specification and size, and, after inspection, the first operation is to chamfer the ends and turn the outside to 1.011–1.012 in., after which the piece is cut off. In the next operation the work is done in a No. 4, Warner & Swasey turret lathe, as in Fig. 1. Here the outside is turned in the roller rest tool shown in position. In the second operation the pins are reversed in the chuck, the other end chamfered and the hole reamed to 0.6865–0.688 inch.

Instead of milling the groove for the binding bolt, as is usual, it is forced in by the punch-press operation, Fig. 2, using the die shown in Fig. 3. The reason for holding the reamed hole in the pin to the tolerance given is on account of the mandrel that goes inside to support the wall of the pin during the punching operation.

Operations on Piston Pins

Turn and chamfer O.D.—Chamfer one end inside and cut to length
Chamfer other end inside and ream
Punch groove
Carbonize and harden
Clean
Wash
Rough grind O.D.
Wash
100 per cent inspection
Lap

The first step is to insert the mandrel shown at *A* and *B*, Fig. 3. The mandrel is made in halves so as to be easily removed after the wall has been forced down to form the groove. With the mandrel in place the pin is put in the vise or die as shown at *C*, and held in place by the screw *D*, this forcing the two halves of the mandrel together.

The square on the end of *A* locates the depression in the two halves of the mandrel in the upper position to receive the metal forced down by the punch. The pin is held on its circumference by the cam-operated jaw

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shown at *E*. A pin, with the mandrel in place is shown in front of the die in Fig. 2. The pin has been turned to show the groove, and the clear, sharp outline should be carefully noted. This outline is as clean as though milled, and shows great care in proportioning the contours of the punch and the mandrel. After punching, the screw *D*, Fig. 3, is withdrawn and swings back out of the way so that the pin and mandrel can be readily ejected by the rod *H*.

After grooving, the pins are carbonized and hardened, then thoroughly cleaned and washed. They are then rough ground on the outside diameter, in the Heim centerless machine shown in Fig. 4. The pieces are fed in by gravity, using a trough at the back of the machine, and slide into a box after they come through the machine.

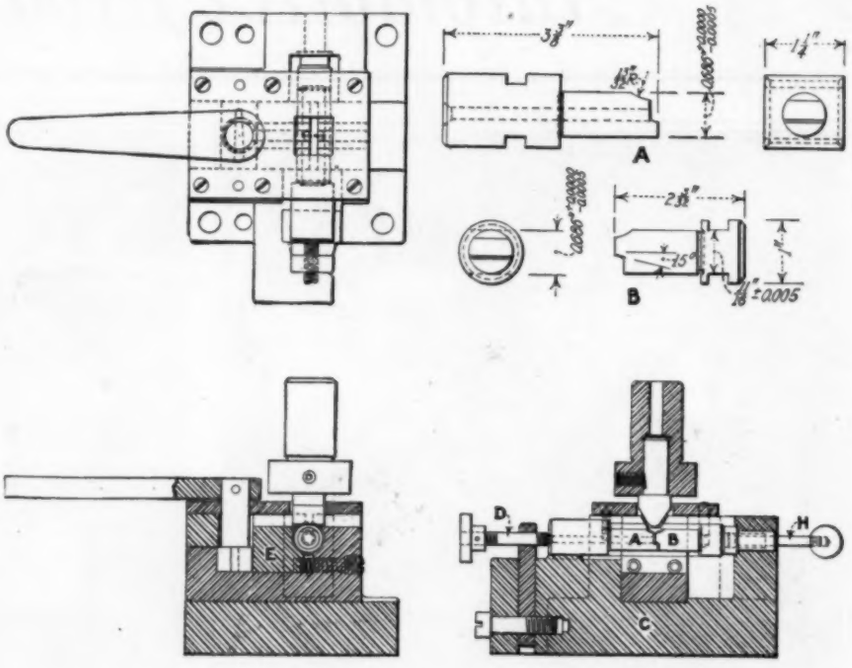
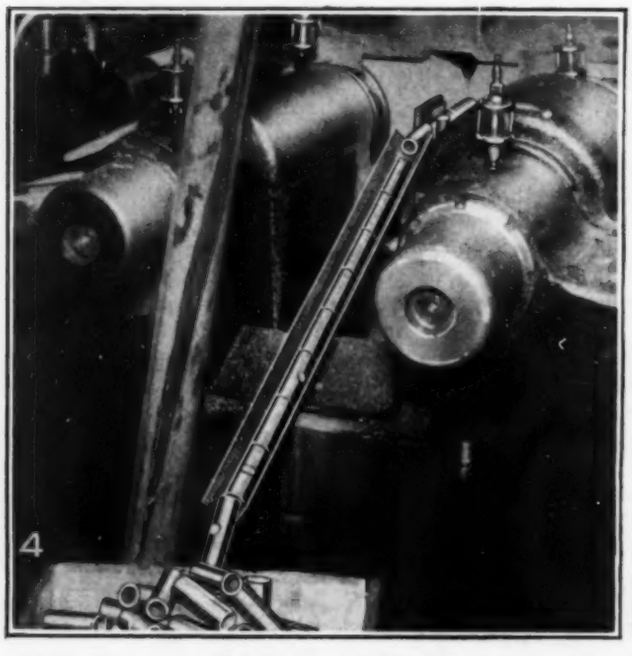


Fig. 3—Details of punch and die used

In finishing the pins, they are again mounted on a mandrel, as at *A*, Fig. 5. The mandrel functions as a driver only. In addition to the mandrel, a special backrest is provided as in Fig. 6. Both the lower and back jaws are held in a fixed position by adjusting screws. The upper jaw is movable to permit the pin and its mandrel to be readily inserted. Fig. 6 shows the location of these jaws and how they support the work with relation to the grinding wheel. The machine is a Norton 6x32 in., using a 60-M Crystolon wheel. The adjustment of the lower shoes is by means of wedges as shown at *A* and *B*. The back rest has a direct adjustment. This set-up is, in reality, a modification of the centerless principle, and has been found to be very accurate.

The pins are then carefully washed, inspected with a ring gage, 0.0025 in. over size, and go to the Bethel-Player lapping machine shown in Fig. 7. Here the pins go over the studs that are set at a slight angle and have a retainer slipped on the end. One of the studs is shown at *A* without the piston pin in place. The lapping machine has an eccentric motion and is now



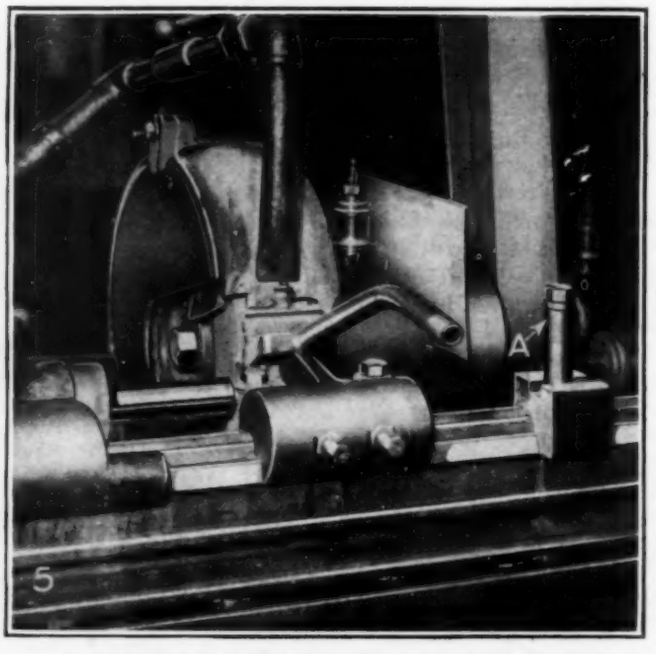


Fig. 4—Rough grinding on centerless. Fig. 5—Finish grinding on mandrel

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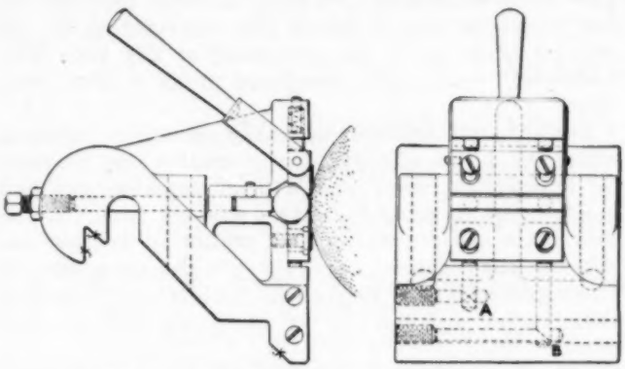


Fig. 6—Details of grinding back rest

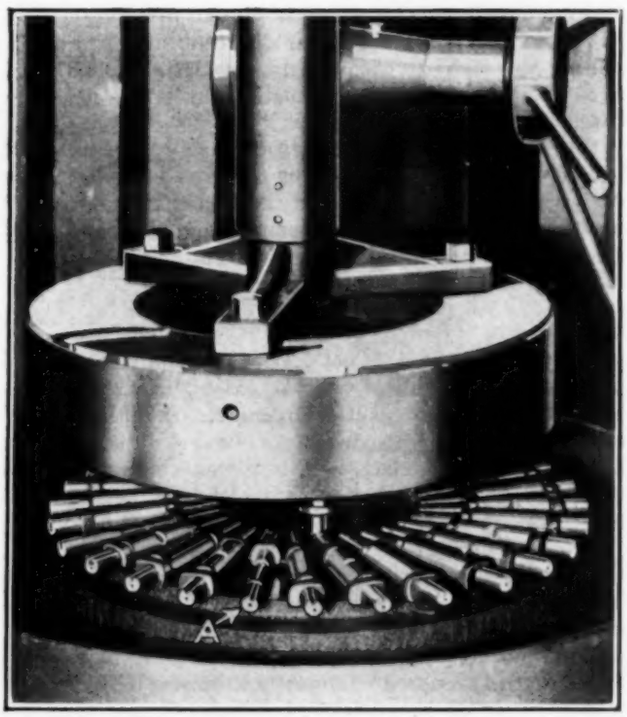


Fig. 7—The final finish by lapping

a standard method of finishing piston pins, where accuracy and smoothness are the chief consideration. The piston pin is perhaps as good an example as we have available of the increasing refinements in automobile manufacture. The accuracy of the pins and the care taken in selecting the pin for the piston, adds materially to the life of the engine.

Many people have an erroneous idea or the purpose of interchangeable manufacture and consider that the manufacture of parts on the interchangeable system is principally to make pieces so they can be used to replace similar pieces that have been badly worn or broken. Undoubtedly this is an important item, but it is not by any means the principal reason. The reduction of manufacturing costs by means of interchangeable manufacture is the primary reason for its use. Any other idea is secondary and would hardly be considered.

Abstracts

from other publications

Bus Maintenance

The annual overhaul of a motor bus is accomplished by disassembling the entire vehicle and rebuilding it. The annual overhaul shops should consist of first, a disassembling department, with proper facilities for removing bodies; second, a cleaning department; third, a unit overhaul department; fourth, a machine shop, forge and sheet metal department; fifth, a soldering, brazing and welding department; sixth, a tire department; and seventh, a body department.

The disassembling department removes the body and completely disassembles the chassis for cleaning. No effort is made to get the same units into the same general assembly, and thus the original identity of any vehicle is lost. A. E. Hutt in *The Timken Magazine*, February, 1926, p. 573.;

Machines Reo Engines

Efficiency has been attained in the engine department of the Reo Motor Car Co., Lansing, Mich., by arranging all lines of machines at right angles to the engine assembly line which runs along one side of the building. The various lines of machines are so located that the different parts are delivered to the assembly line at exactly the points where they are needed for assembly into the engines. For instance, the cylinder blocks are finished by the first rows of machines in the department for feeding the assembly conveyor at the starting point. Rough forgings or castings trucked to the beginning of each line of machines are finished complete when they reach the opposite side of the shop.—*Machinery*, April, 1926, p. 645.

Airplane Gears

The material used in Liberty engine gears is a chrome-nickel alloy containing carbon to permit heat-treatment that will result in great tensile or breaking strength together with long wearing life. The gears run over 300 hours of actual flying service. The steel bars are rolled from ingots and are closely inspected while rolling and after rolling. The bars are drop-forged to produce the gear blanks. The forgings are thoroughly and uniformly annealed to remove forging strains and to give a uniform molecular structure. They are then rough-machined and sent to the heat-treating department to be normalized. After this process they are finish-machined leaving material for grinding to final dimensions. After the finish-machining operations the gears are hardened for strength to wear. They are then cleaned of all burned oil accumulations and inspected to see if they are in accurate enough condition to perform the final grinding operations. A final inspection then completes the gears. S. A. Smith in *U. S. Air Service*, April, 1926, p. 29.

The Plight of Industrial Designs

By John Dashiell Myers

EVERY manufacturer and dealer whose products involve industrial designs, no matter how simple they may be, has a vital interest in legislation now pending in Congress which not only threatens the development of industrial art, but may seriously embarrass industry generally.

The substitution of copyright for patent protection for designs and the repeal of the design patent laws is the basic change embodied in this legislation, which is officially known as House Bill 6249. The change sounds simple enough, but owing to the fundamental difference between copyrights and patents, its effects are far-reaching.

The degree of protection afforded against infringement, for instance, will be much less than under the present patent laws. On the other hand, manufacturers, dealers, and the public generally will be confronted with the prospect of endless litigation under copyrights indiscriminately registered for designs that are not now entitled to protection at all, such as those lacking novelty or having merely a trivial character.

No Protection for Later Designs

Taking a specific example, if a manufacturer developed at much expense a distinctive and very valuable industrial design and obtained a copyright registration for it, he would be unable to protect his design against anyone else who later, independently and without copying, produced a design identical with his work. Such a manufacturer would have to share his market with the producers of the later design. Under these circumstances, there will naturally be little inducement to manufacturers to spend large sums developing distinctive articles only to have their designs duplicated later by competitors who would share in their commercial possibilities.

Should such a manufacturer seek protection in the courts, he could not obtain relief under his copyright unless his competitor's design was in fact copied from his, and this would present an obviously difficult point for proof. This difficulty is not now raised at all as the test of infringement under the design patent laws is based solely on substantial resemblance. If one design resembles another which is patented, it may not be manufactured, used or sold without infringing, regardless of whether it is a copy or is independent work.

Another far-reaching effect of this proposed change will be that it will enable copyright monopolies to be created in designs which are now the property of any manufacturer who desires to use them. These indiscriminate copyright registrations will present a wide opportunity for harassing tactics and will breed much litigation.

A concern marketing an article of a particular design which had been common property for many years would be open to attack at any time under a copyright registration which could be readily obtained by another for an identical, or substantially identical, design. Under these circumstances, there would be no infringement if the design so marketed had not been copied from the copyrighted work. But even if this satisfactorily appeared from the evidence and the concern should win, the expense of litigation might make it a loser.

Confusion of rights and consequent law suits will also grow out of the fact that the proposed change will make it possible for different persons to secure separate copyright registrations on identical designs. This would manifestly be a great hardship upon the one first producing such a design and copyrighting it. He and his trade might be confronted at any time with widespread competition developed under a later copyright.

The situation would be menacing enough in instances where the design of the later registration was produced by independent work and without copying, but how much worse it would be if this was not true. Yet as copyrights are registered as a matter of routine and without examination, the door will be open for the unscrupulous readily to cloak themselves with copyright registration, and the way of the pirate will be made easier.

"The bars will be let down" in other ways and permit the copyrighting of designs of a trivial character, and many others which do not meet the requirements for a patent. This is because of the different standard determining the right to a copyright, as distinguished from a patent, and the different method by which it is secured.

One of the principal objects of the proposed change is to avoid the delay involved by examination in securing design patents. It is claimed that designs, if promptly marketed, may be copied by competitors, cheapened, and their value destroyed before patent rights can be obtained under which suit can be brought.

Present Law Ineffective

The need, if any, does not justify the radical departure proposed. The difficulty, if it exists, is not general, but applies only to particular cases. Doubtless relief could be obtained by appropriate changes in the present laws or their administration, but even now patents are promptly granted on designs which are not open to objection.

Creators of designs which meet the requirements of the patent laws will scarcely be willing to accept a monopoly of less value, in order to avoid the short delay involved in examination. Of course, those whose designs do not meet these requirements may be in favor of the proposed change; not, however, because of merely avoiding short delay, but because now they are not entitled to any kind of monopoly at all. This, after all, is the real purpose back of this proposed change in the law.

The sum and substance of the matter lies in the fact that copyright is not an appropriate form of protection for industrial designs, because it has been developed to deal with literature and the fine arts. Industrial designs, on account of their relation to the useful arts, involve conditions of a different kind and which are more analogous to those under patents than under copyrights.

We need some way of re-establishing the old pride in the craft of metal working that comes from a knowledge of the part played in turning out a fine piece of work. There should be more pride than ever, because we are doing better work than ever before. But it is so sub-divided that it is more difficult for the individual to feel his responsibility in the completed machine. What we need is a way of putting the individual or personal feeling in the group job.

The Cam Indexing Motion

By Bernard Sassen

The principle of indexing by cams and its application —Unlimited number of stations and possibility of higher speeds give advantage over Geneva stop motion

THE USUAL method of imparting intermittent rotary motion to a disk or cylinder is the well known Geneva stop mechanism. While years of successful experience with this device undoubtedly entitle it to consideration where such a motion is desired, the somewhat less common method of indexing to be described in this article often seems to offer distinct advantages.

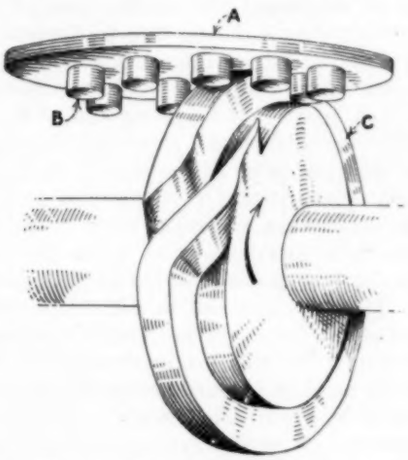


Fig. 1—Principle of the cam indexing motion

Although the principle of cam indexing is not new, being described in most books on mechanical movements, these descriptions are usually very inadequate, and it is rarely encountered in actual use. The writer has had occasion to incorporate it in the design of a number of automatic machines, and it is possible that the rather more elaborate manner in which it is presented here will be found of value to designers.

The principle of the device is illustrated pictorially in Fig. 1. The indexed member A, which for lack of a better name will hereafter be called the dial, is provided with rollers B, corresponding in number to that of the pauses per revolution, or as they are generally called, the stations. These rollers are equally spaced in a circle concentric with the dial. The cam C has a developed contour, as amplified in Fig. 2, and revolves continuously. During the pauses the dial is rigidly locked by two of the rollers bearing against the parallel portion C_1 of the cam. The dial is rotated by the surface C_2 bearing against one of the rollers, the action being identical to that of any oscillating follower operated by a "barrel" cam. A departure from theoretical line contact takes place due to the circular path of the rollers and the resultant slight movement of the axes of the rollers tangential to the circle of the cam. This movement is negligible if the number of rollers is six or more, and if the diameter of the cam is made proportionately large enough. To reduce this tangential movement to a minimum, however, the axis of the cam shaft should, of course, be positioned about as shown in Fig. 3, namely at a distance from the center of the dial, which can most clearly be expressed algebraically as $R \cos \frac{180°}{n}$, where R is the radius of the roller circle, and n is the number of rollers.

In laying out the cam, surface C_3, Fig. 2, should be made so as to just clear the roller that follows the one bearing against surface C_2, in order that the motion will be positive in both directions. The contour of surface C_2 should be designed to impart uniformly accelerated motion up to the half-way point and uniformly retarded motion from there to the end (i.e., two parabolas placed end to end, if the slight tangential movement of the rollers, referred to above, is ignored) consistent with correct practice in conventional cam design.

It will be seen that accuracy of indexing is limited mainly by the following considerations: the snugness of the fit of the parallel portion of the cam C_1 between any two of the rollers, and therefore the equality of the spacing of the rollers; the degree in which this parallel portion runs true and is square with its axis; and the absence of axial play in the cam. In cases where great accuracy is required, or where the loads are heavy, the same measures against wear must, of course, be taken as in any carefully designed mechanism. The cam, the rollers and the roller-studs must be hardened, and the first-named must be provided with some form of frictionless thrust bearings (such as shown in Fig. 3) or with a take-up adjustment of some kind to insure that there will be no end-play. As the surface C_3 (Fig. 2) serves only to rotate the dial, its accuracy is of no great importance, and the same applies to C_2, so that if a ground finish is called for in the parallel portion of the cam, it will be unnecessary to grind these surfaces.

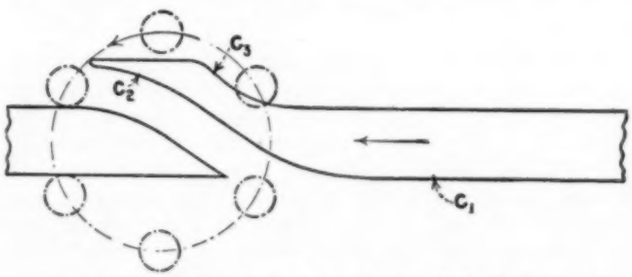


Fig. 2—Developed contour of the indexing cam

In comparing this device with the Geneva motion a number of decided advantages will be observed, and as far as the writer can see, very few disadvantages. In

cases where there are either three, four, or five stations the cam motion is not recommended without the use of gearing such as shown in Fig. 6. In such cases the Geneva motion might be considered the better choice, provided some of the other advantages, to be described later, would not outweigh the added expense and inaccuracy of gearing. On the other hand, where the number of stations is greater than seven or eight, no one would probably consider the Geneva movement without the use of gearing, while the cam motion can be used direct for any number of stations above five.

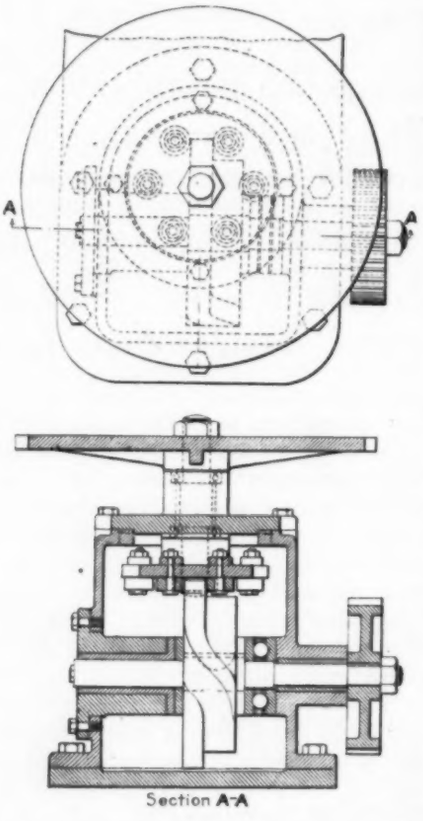


Fig. 3—Typical cam indexing layout with six stations

The outstanding advantage of the cam motion lies in its suitability for far higher speeds than can be delivered by the Geneva motion. Unlike the latter it is almost noiseless. A further advantage—and in some cases the most important, as it affects the capacity of the machine—lies in the fact that the ratio of the duration of the pauses to the time consumed in indexing can be made much greater. In some machines this may not matter, as the indexing period can be utilized to perform other functions, but generally speaking it is entirely non-productive, and should be kept as short as possible.

When we examine the Geneva motion we find that the duration of the indexing periods is a function of the number of stations—surely an illogical state of affairs. Thus, for a three-station disk the angular movement of the indexing member necessary to complete indexing is 60 deg., or one-sixth of a revolution; for a four-station disk it is 90 deg., or one quarter of a revolution; for five stations, 108 deg., or three-tenths of a revolution, and so on, approaching 180 deg., or half a revolution, as the number of stations increases (see Fig. 4).

With the cam motion this characteristic is largely avoided. The only limiting factors of the indexing period are the size of the cam and the maximum permissible incline that the cam may present to the roller—say 30 deg. Thus for the six-station motion shown in Fig. 3, the time consumed in indexing was one-sixth of a revolution, and this could have been reduced somewhat if necessary. Where the number of stations is greater a much shorter indexing period is possible.

Lastly it will be seen that the axis of the cam, while it must lie in a plane parallel to that of the dial, may pass in any direction in that plane; consequently a vertical shaft can always be avoided. A glance at the illustrations will show more clearly what is meant by this. In Figs. 3 and 6 horizontal dials are shown and in Fig. 5 the dial lies in a vertical plane, but the axis of the camshaft in all cases is horizontal. As the source of power, whether it be an individual motor or a countershaft, has generally a horizontal axis, this factor is often an advantage as it eliminates the use of bevel or helical gearing. With a Geneva motion, as we know it, the designer is more limited, since the axes of the indexed and indexing members must be parallel.

In Figs. 3, 5 and 6 designs of mechanisms substantially as actually incorporated by the writer in the design of a number of automatic machines are indicated in their essentials. They have all been in operation for a considerable length of time, and so far have disclosed no disadvantages.

The design shown in Fig. 3 was used where lack of space prevented placing the camshaft far enough away from the axis of the dial to prevent interference with the dial shaft bearing. The cam was therefore placed below it, and the dial shaft provided with another disk keyed to it and carrying the rollers. It is doubtful whether this construction can be avoided if the number of stations is as low as six. In this design the mechanism was entirely enclosed and ran in oil. Sufficient accuracy was obtained from it to function flawlessly where a discrepancy of more than 0.002 inch in the position of the dial would have resulted in a breakage.

The design shown in Fig. 5 was used where a larger number of stations permitted a larger diameter for the roller circle without increasing the throw of the cam, thus making it possible for the latter to clear the dial shaft bearing. The number of stations in this case was twelve. It is apparent that in a case of this kind the cam indexing motion is almost ideal and is unquestionably superior to the Geneva stop motion, as much from the viewpoint of smoothness of operation and ac-

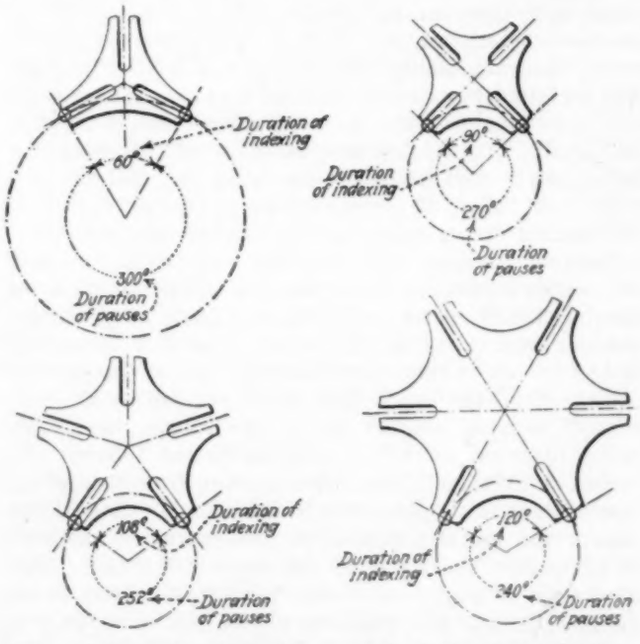


Fig. 4—How the indexing period of the Geneva stop mechanism is governed by the number of stations

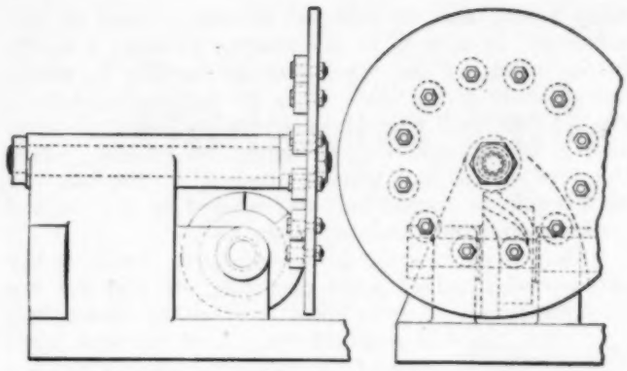


Fig. 5—Twelve-station indexing cam with dial in vertical plane

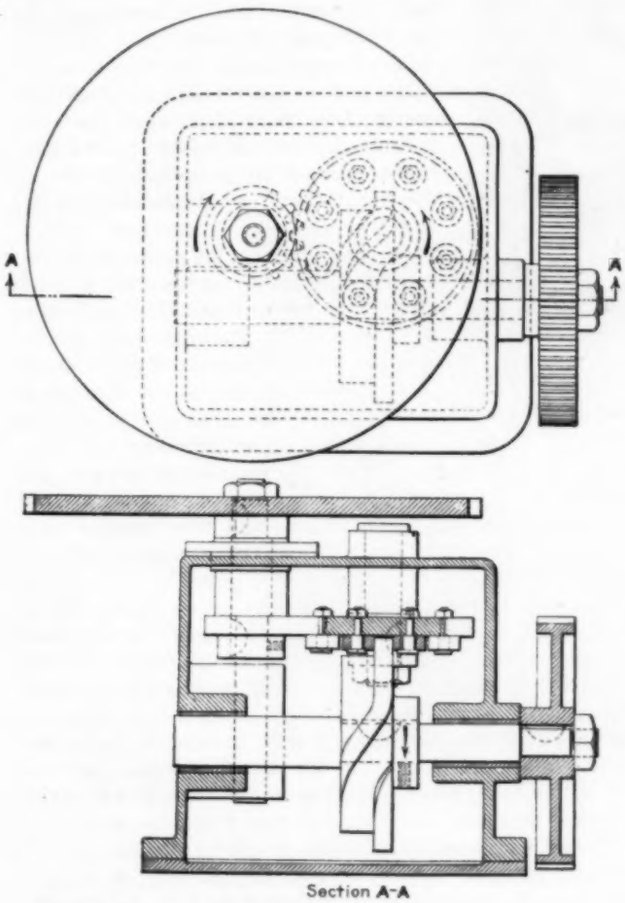


Fig. 6—Indexing dial with four stations requires gearing in order to avoid harsh cam angles

curacy, as of simplicity and cheapness of construction of the entire unit.

In Fig. 6 is shown a design where the dial had only four stations, which necessitated the use of gearing since harsh angles and other drawbacks make it impractical to operate a disk with less than six stations directly. In this case the advantages of the principle over the Geneva motion are not so apparent, as the latter is at its best where the number of stations is small. The cam motion was here used, however, with a view to its more economical timing characteristics as pointed out above, and on account of its suitability for higher speeds. A kinematic analysis such as the one made by Bernard M. Fine in his interesting article "Some Characteristics of the Geneva Movement," page 913, Vol. 63, of the *American Machinst* will not be attempted here, as the shape of the cam can be varied *ad libitum* to give almost any desired result. The greater flexibility of the device in this respect will, by many, be considered another strong argument in its favor.

Buying a Second-Hand Lathe

BY ENTROPY

Four people out of five, when they look at an old lathe, reach for the tailstock handwheel or the cross-feed handle, and try them to see how much backlash there is.

I caught myself doing the same thing the other day, though I have taken most of the backlash out of hundreds of such machines before showing them to customers. Habit is strong, but if a man really wants to find out how a lathe has been treated there are better places to look. For example, if the lathe is skidded, as it usually is, the countershaft is underneath and handy to look at. If the bearings are worn loose, and the friction clutches show wrench marks where someone has repeatedly tried to set them up tight, it is a fairly safe bet that the lathe had a hard time. The countershaft is usually more neglected than the machine itself and usually wears out first, except in shops where everything is well taken care of. And if everything about a lathe is well taken care of there will be very little wear even if it is pretty old. In that case, the design is what should determine the value. If it was rigid for its times, the chances are that if well taken care of it is very little worn, even if it is ten or fifteen years old.

Another place that shows wear early, if it is going to show at all, is in the rocker gears for reversing the feed. It is very easy to forget to oil these little gears, yet they run most of the time that the lathe is in use. If designed right, and made to fit well and kept oiled, they run on and on indefinitely, but if not designed right nor well fitted, they soon wear loose and rattle. The whole workmanship of the lathe is very likely to be no better than that of these little gears.

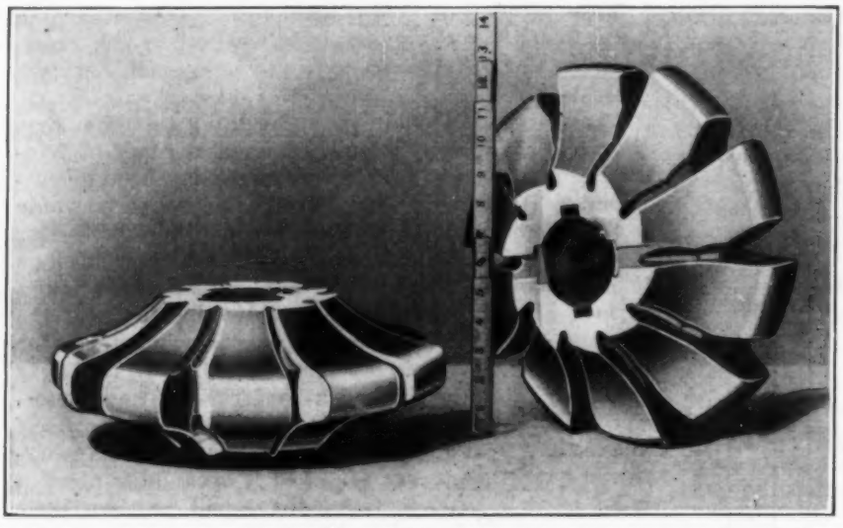
The apron is another place where wear begins to show early on account of design or workmanship. Every operator just runs his lathe until something happens, then for the first time he finds out what is behind the apron. If there are a lot of little narrow faced gears running on overhanging studs, the chances are that some of them have been well oiled and some have not. Some builders seem to think that some kind fate will keep their make of lathe from getting clogged up with grease and iron dust, and they put in oil tubes that wind around in devious ways, when it would be just as easy to drill straight holes that could be cleaned out with a wire and a pipe cleaner, as often as necessary.

And then again, the kind of oil that has been used makes a great deal of difference in the value of second-hand tools, that is in the real value. It may not affect the price, nor the sale, because the customer cannot look back into the past and see what oil was used, but there is plenty of oil on the market that ought to carry with it an endowment fund for the machinery it is used to lubricate. That is, no one can afford to use it as a gift.

Biggest One-Piece Gear-Tooth Cutter

Some weeks ago there appeared in the *American Machinist* a description of an unusually large rotary gear-tooth cutter furnished to the Farrel Foundry & Machine Co. by the Union Twist Drill Co. It has since been learned that even larger cutters of the same type have been made by this company.

Each of the pair of cutters illustrated is made from a forging of Rex AA high-speed steel. Diameter of the bore is 3 in. and the thickness through the hub is 5¼ in. The outside diameter over the points of the teeth is 13¼ in. This fact is not apparent in the illustration because the cutter rests on the relieved portion of the tooth.



Pair of one-piece gear-tooth cutters believed to be the largest made

As will be seen, two longitudinal keyways extend through the bore of each cutter. In addition there are two radial keyways, one across each face of the hub, at right angles to the plane of the other keyways. Each cutter weighs 92 lb. They are believed to be the largest single-piece cutters built.

A Multiple-Operation Press Tool—Discussion

By Rob White

A multiple-operation press tool—meaning by the term a self-contained mechanism to go into a punch press and perform several operations at one stroke, as described by John Strama on page 251, Vol. 64, of the *American Machinist*, in his article under the above title—may have disadvantages that outweigh its time-saving qualities. I am reminded of a device that a fellow workman of mine designed and made some years ago to shear the wick slot in the cone of a lamp burner, at the same time that the shell was trimmed and several small holes were pierced in the flange.

If the reader has in his possession a lantern or a lamp made to burn kerosene oil (they are not plentiful in these days of electric lights), he may observe by looking at the cone-shaped shell through which the flame of the wick burns, that the slot extends down both sides of the cone so far that it would puzzle him to make a die to shear it in one operation.

It puzzled the makers of that class of goods for many years; does so still for all that I know to the contrary. It used to be the practice to make a die to fit the inside of the cone, with an opening to match but one-half of the slot. This die was mounted on a die-bed that held it in the press at an angle of about 45 deg. and the slot was sheared in two strokes. After the first stroke had pierced one-half of the slot the shell would be turned half-way around on the die and struck again, thus completing the slot.

This was a time-consuming operation, requiring the services of a skilled press operator, and was not the least dangerous of press operations for the reason that it required the almost constant presence of the operator's hands under the tools; hence my friend conceived the idea not only of doing the job in one stroke of the press but of combining it with trimming the shell and piercing the small holes in the flange; hitherto separate operations.

We had no draftsmen or tool designers in those days other than the toolmakers themselves, so my friend having convinced the boss that he was on the right track, went ahead with his engineering feat.

He made the die of a shape to conform to the inner contour of the shell as before, but he made the opening to the full contour of the slot, of course coming away down each side of the cone. If he had carried the opening at full width clear through the die, as would seem to be necessary to clear the scrap, he would have cut the die almost in two; but he had a trick worth two of that. He made the slot straight across the top of the die and then bored a comparatively small clearance hole from the under side of the die to meet it.

Shaping the flange part of the cone-shaped die to conform to the edge of the trimmed shell was ordinary every-day work—the edge of the flange on the die becoming the trimming punch, for which the corresponding die was held in the upper tool holder. Making the openings in the flange to pierce the small holes was child's play; as was also the small piercing punches set in the upper tools. Making and placing the shearing punches to shear the wick slot was a man's-size job.

These punches were made to slide horizontally in suitably shaped bosses on the die-bed, and were held back out of the way of the descending tools by springs.

When the tools came down to trim the shell and pierce the small holes in the flange the shearing punches remained decorously quiet, but at the bottom of the stroke the swinging latches engaged the ends of bell-crank levers connected with the sliding punches so that when the gate commenced to rise things began to happen. Just as soon as the upper tools had risen far enough to clear the shell, these punches shot forward from the sides to shear out the slot.

In order that the two punches should not collide at the middle of the die it was necessary to have one of them strike far enough in advance so that it could get back out of the way in time to avoid its mate. The ends of the punches were so shaped that between them the scrap was rolled up almost into a ball, so that it dropped through the small clearance hole in the die.

The tool worked—it actually did.

Odds and Ends of Frisco Repairs

By Frank W. Curtis
Western Editor, *American Machinist*

Grinding connecting rods—Method of handling motion work—Hardening furnace used—Boring flue sheets—Indexing milling fixture—Oxygraph machine

GRINDING operations in the railroad shop are becoming recognized as a necessity for handling many classes of engine repairs. At the Springfield, Mo., shops of the St. Louis-San Francisco Ry., better known as the Frisco lines, there may be seen several modern applications of grinding, some of which are illustrated. Grinding equipment at these shops has been applied to work that can be handled advantageously from the standpoint of production and quality.

Connecting rods are ground on both ends in a Heald grinder as shown in Fig. 1. The rod is held by a U-clamp to an angle plate that is located on the machine table. A level is used to locate the work at a correct vertical plane. The projecting end of the rod is supported on a stand as shown. To compensate for movement of the rod as the table is oscillated, two rollers are placed between parallels. This arrangement eliminates any excess strain to be applied to the machine table.

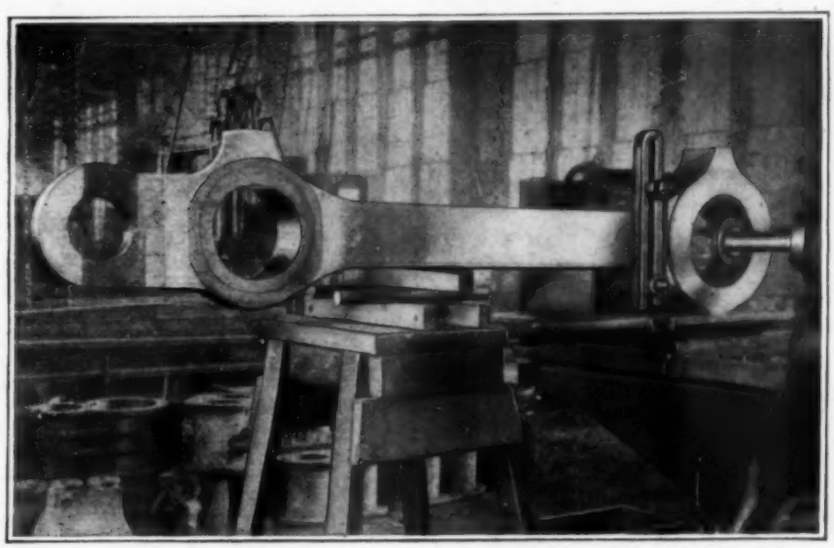


Fig. 1—Set up for grinding connecting rods

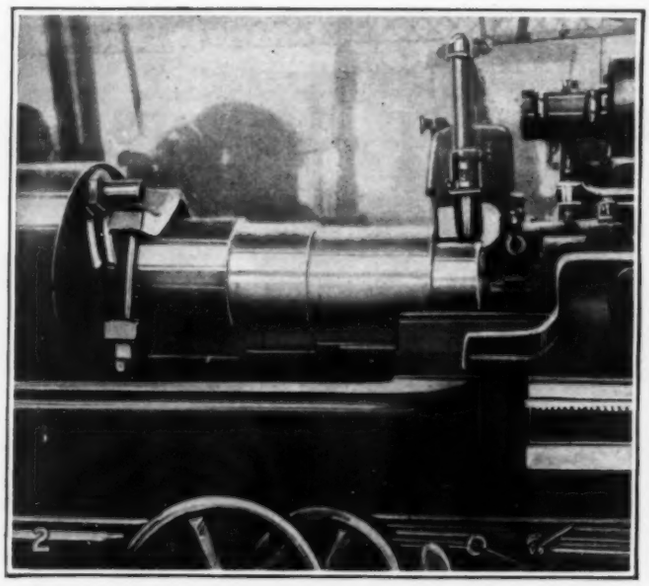
The rod is ground at the smaller end to 9.5 in. and at the larger end, shown in grinding position, to 11.75 in. The depths of the holes are 5 and 6 in. respectively. An abrasive wheel, 9 in. in diameter and 1 in. in thickness, is used. Loading and unloading of the work is accomplished by means of chain blocks that are mounted on an overhead track. The operation is completed in 2 hr., floor to floor time.

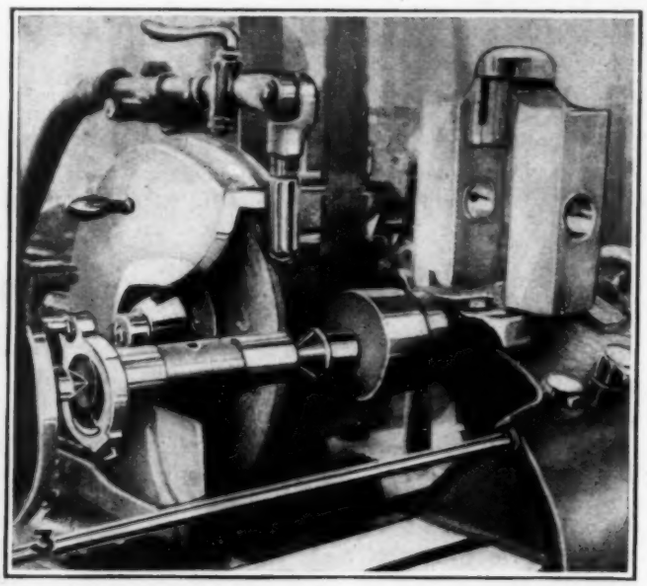
Another grinding operation is the finishing of main driving pins on the 20x32x96-in. Norton grinder illustrated in Fig. 2. The work is supported on centers in the usual manner. Two bearings, 9.0 and 9.75 in. in diameter and 6 and 9 in. in length, respectively, are ground to size. Between 0.015 and 0.02 in. of metal on a side are removed. The wheel used is 24 in. in diameter with a face 4-in. wide. An overhead air-hoist is used for transporting the work. The operation is completed in 20 min. In addition to this work, the machine is used for grinding smaller sizes of pins, piston rods, valve rods, crosshead pins and similar cylindrical work.

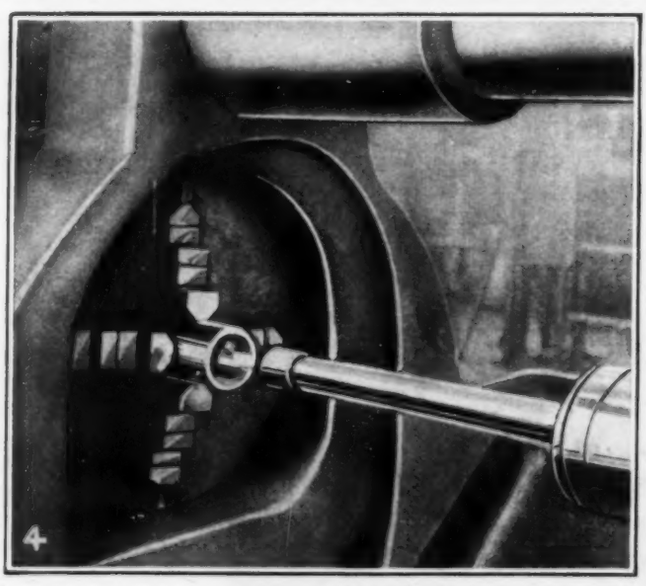
All pins used in motion work, and the holes of the parts into which they fit, are ground to size to insure accuracy and long wear. Fig. 3 shows the grinding of a hardened pin for a valve crosshead as handled on a Landis grinder. The ends of the pin are ground to fit the hole in the crosshead shown on the tailstock of the machine. The operator measures the approximate size of the hole with calipers and grinds the pin slightly larger than the size required. The work is removed from the machine to check its size with the hole, and to determine the exact amount of metal that remains to be removed. A small amount of material then is ground off the work, after which the operation is repeated until an accurate running fit has been produced. The pin bearings are approximately $1\frac{3}{4}$ in. in diameter and $2\frac{1}{2}$ in. in length. An abrasive wheel, 14 in. in diameter and $\frac{1}{2}$ in. in width, is used. The pin is completed in 15 to 20 min., this time being required due to the necessary fitting. On the same machine are ground the outside diameter of bushings, reverse-fulcrum pins, reach-rod pins and other motion work.

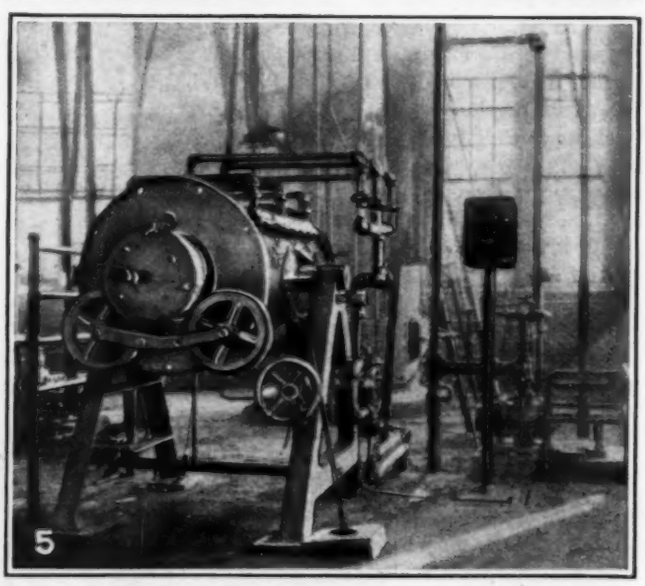
Bushings that are used in motion work are ground on the Bryant chucking grinder illustrated in Fig. 4. The work is a union-link bushing used at one end of the combination lever. It has a bore of $1\frac{3}{4}$ in. in diameter, 3 in. in length. A four-jaw chuck is used for holding the work. The grinding requires 12 min., floor to floor time. This type of work is distributed to two machines, keeping them in constant operation.

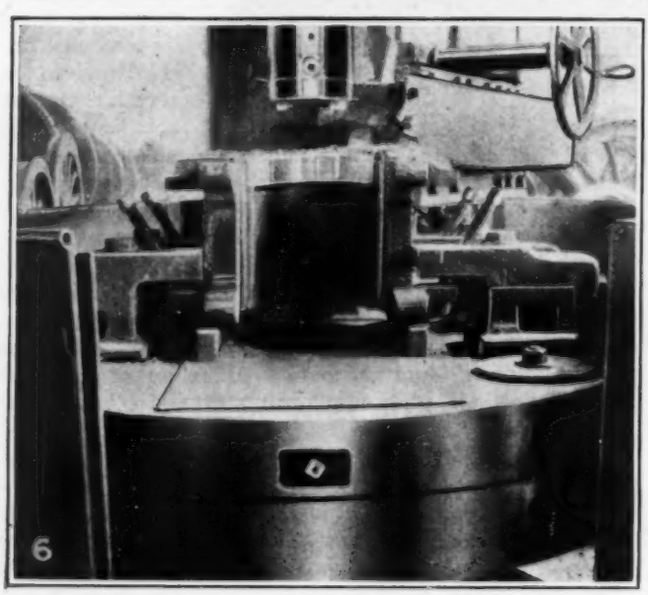
The necessity of correct hardening for motion work











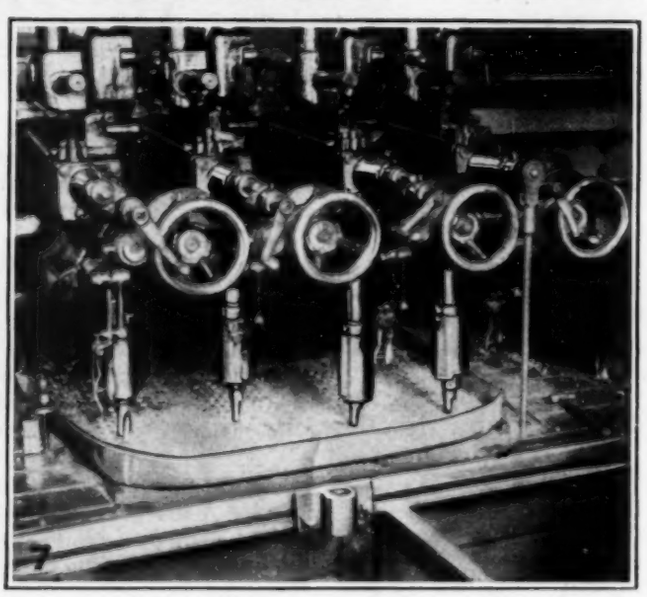


Fig. 2—Grinding a main driving pin. Fig. 3—Grinding a valve-crosshead pin. Fig. 4—Internal grinder for motion work. Fig. 5—Furnace for carbonizing small parts. Fig. 6—Boring and facing driving boxes. Fig. 7—Flue-sheet boring machine

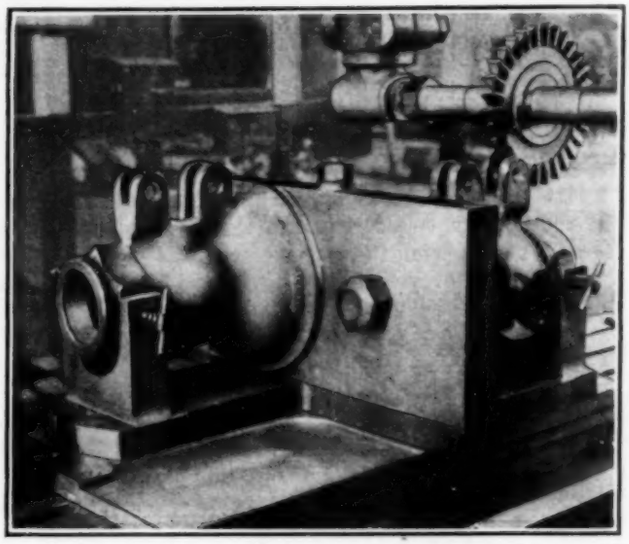


Fig. 8—Milling whistle bodies

has been responsible for the addition of a carbonizing unit that has been installed in the forge shop. The American gas furnace shown in Fig. 5 is used for this work. For the larger parts, the heat is started at 1,500 deg. F., and then raised to 1,800 deg. F., while for lighter work, the heat is held constantly at 1,700 deg. F. The gas used acts as a carbonizing agent and the length of time required to penetrate the surface of the work depends on its size. Other units handled in the furnace are spring and brake rigging, pins, small links and miscellaneous shop tools such as wrenches.

The gas used for operating the furnace is made by a Galusha gas producer that is located behind the furnace. The producer comprises a 5x8-ft. tank that is filled with coke. At the bottom of the tank is maintained a fire, 1 ft. in depth, that is provided with a suitable air intake and a constant spray of dry steam. The gas that rises is passed through a filter and then pumped to the furnace at a pressure of 2½ lb. To operate, the producer requires 25 buckets of coke per day. The gas for heating the furnace comes straight from the producer, whereas that for carbonizing is the same with the exception that it is passed through a naphtha tank to enrich it in carbon.

Driving boxes, after they have been provided with brasses, are bored and faced on the Sellers boring mill shown in Fig. 6. The driving box is placed on two parallels, then clamped by a four-jaw universal chuck of special design for this type of work. Four setscrews are tightened against the work to hold it securely against the parallels. A compound type of table is provided for shifting the work after it has been clamped in the event it is off center. Two boring and two facing cuts are required to size the work. The Davis boring bar, used for finishing the hole, is provided with a tool for crowning purposes. The work can be completed in 10 min., but as it is necessary for the operator to obtain the journal size for each box, the average is approximately 20 minutes.

When the flue sheets are required they are laid out, the holes are punched to 1 in. and the edge is flanged, after which they are bored in the Niles-Bement-Pond flue-boring machine shown in Fig. 7. Four spindles are used simultaneously as illustrated. The flue sheets are mounted on four supports that raise the work from the table a distance of 1 in. Two clamps are used to hold the work in place. The flue sheet shown is ½ in. in thickness and has 312 holes that are bored to 2 in. in diameter. The boring tool has three spiral flutes and is provided with a pilot that has a cutting portion at the end to enlarge the punched hole in case it is burred or undersized. The operation shown is completed in 4½ hr. Other types of sheets also are handled on the machine necessitating the boring of holes from 8½ to 15 in. in diameter. Special trepanning tools are used for holes of this size.

In Fig. 8 is shown the indexing fixture used for milling slots in whistle bodies. The operator loads the work on one side of the fixture while the cut is being taken on the opposite side. The component is drawn against the upright member of the fixture by a capscrew that is threaded into the whistle body. The overhanging portion of the work is clamped by two setscrews that locate against its hexagon portion. A ½-in. slot is machined through two bosses by a ¼x6-in. side milling cutter. Indexing is accomplished by removing a pin that fits into a slot at either end of the fixture, after which it is free to revolve on the base. The nut shown on the top of the upright member is used for locking the fixture after it has been located. The work is handled in lots of 25 pieces. The average time per piece is 2½ min. The fixture is simple in design and unlike the usual type of indexing fixtures seen in high-production shops, yet it is capable of satisfactorily performing an operation that was somewhat cumbersome. The saving in set-up time alone soon paid for the cost of the fixture.

An oxygraph machine is used for cutting out such parts as link lifters, combination levers, union links, brake-adjusting rods, truck-carrier irons, frame pedestals, binders, eccentric rods, pony truck equalizers, frame sections and dry-pipe collars. Fig. 9 shows the machine unit set up for cutting a driving-box equalizer that is 1¼ in. in thickness. On the floor in front of the machine is shown a finished piece and the scrap edge that is cut from it. The templet of the form to be cut is placed on the table at the right-hand end.

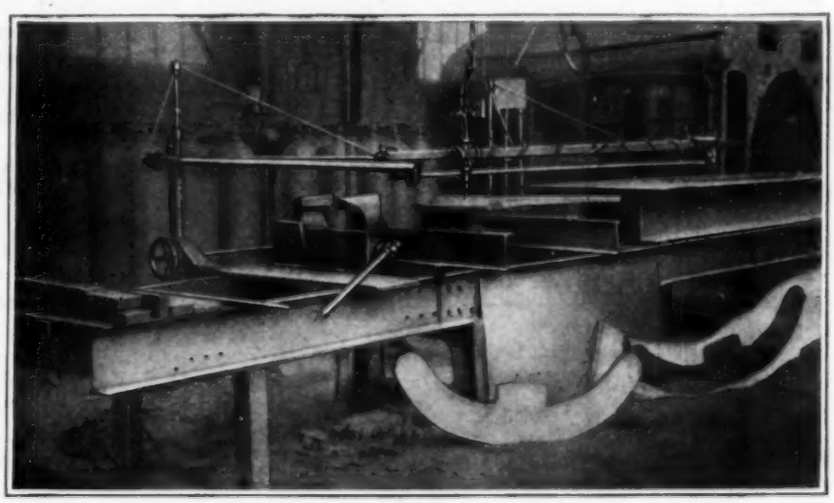


Fig. 9—Oxygraph cutting machine

The templet consists of a ⅜-in. sheet-metal form that is riveted to a ⅛-in. sheet-metal mounting. On the left-hand end of the pantograph arm is attached a tracing point that is hand-guided around the form of the templet. The opposite end of the arm is equipped with the cutting torch, under which is located the work to be cut.

The cutting gas is furnished from two sets of tanks shown in the rear of the machine. Each set comprises ten acetylene and one oxygen tank arranged with cut-off valves so either set can be put in operation while the other is being replaced. This feature permits the continual use of the machine. The equalizer illustrated is cut in 8 min., floor to floor time. Links that are 3½ in. in thickness are cut on the inside and outside surfaces from the rough in 20 min. Combination levers are finished completely, with the exception of the holes, in 1 hr. This operation includes cutting two ways or a total of four sides.

The stands shown in Fig. 10 are used in connection with air-compressor pump repairs. When a pump is received it is placed on the stand and dismantled, after

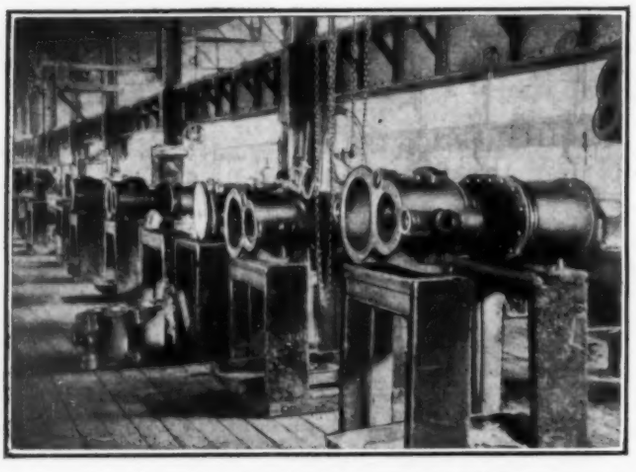


Fig. 10—Stands for pump repairs

which the mechanic examines it to determine the repairs that are necessary. The parts then are distributed throughout the shop for reconditioning in the usual manner. The advantages of having a large number of these stands is that no loss of time is experienced in the event a pump is held up for certain parts. The operator can work on the next unit until the delayed part has been received.

Records Show Steady Increase in Sales of Closed Cars

The growing use of closed automobiles is indicated by a recent statement of the General Motors Co. that shows an increase from 28 per cent in 1922 to 63 per cent in 1925. It is also significant that January and February of 1926 were 84 and 82 per cent respectively as against 47 and 54 per cent in 1925. With few exceptions each month of the year shows an increase in the percentage of closed cars over the previous month, indicating that the summer months do not cause a demand for open cars. This all points toward more and more machinery used in making closed bodies, in which metal is becoming an important factor.

Seen and Heard

By John R. Godfrey

Just what is overhead?

THE term overhead, like charity, covers a multitude of sins—and both are used wrongly in many cases. Just as scientific management was used to cover any alleged improvement, so "overhead" has become a catch word in the minds of many. The main trouble is that we think of overhead as being synonymous with waste, which is far from the truth.

It's very much like the term non-productive labor as applied to every one who does not actually turn out the parts and finished product from the shop. As so applied, it is the greatest misnomer that ever misled a manager.

When a designer spends a few hours or weeks in devising a machine or part that can be made for half the price of the old one, we too often have the nerve to charge it up to non-productive labor. Yet we'd pat a shop man on the back who devised a method that saved even ten per cent of the cost. I'm not objecting to the shop man getting "pats"—he needs and deserves a lot of 'em—but it's a poor system that classes the shop man as a "producer" and puts the man who makes it possible for the shop man to produce, in the parasite class.

One great trouble with managers of small vision, is that they pick up some word or phrase and use it as the only road to business salvation. We've had a bunch of these words since Taylor began his drive, and while we have advanced in many ways, the "one word" managers have caused a lot of grief for all concerned.

Overhead should be divided into classes. If it helps production or safeguards a business, it is very likely to be an economical investment rather than an expense. If it is a waste, such as oriental rugs on the floor of the cafeteria, it should be eliminated at once.

Part of the trouble comes from using direct labor as a base to calculate so-called overhead. For the more we reduce labor cost by the use of new and better machinery, the lower the percentage of direct labor to the total cost. Just suppose we could put in new machine equipment that reduced the direct labor cost to only ten per cent of the total costs, and yet produced the article at a lower total cost than before. Here we'd have an overhead of 900 per cent based on direct labor, together with a cheaper and better product.

Years ago, some one made a study of a number of businesses and found that, at the time, the costs charged to overhead averaged about 150 per cent. Since then this figure has served to be the law and the gospel for managers of the "one-track mind" persuasion. Economies have been passed by because the so-called overhead would go above the dead line of 150 per cent. It's high time we looked overhead square in the eye, and found out that it isn't a bugaboo, but a real and necessary part of business.

Cold rolled, turned and ground shafting is, and apparently always has been, made with tolerances from basic size to below basic. Very little of it is fully up to basic size and it works in well with holes made with unilateral tolerances from basic to over basic.

Pressure vs. Gravity Die-Casting

By George Mortimer
Birmingham, England

Accuracy in die castings often exaggerated—Gravity casting preferable for parts requiring strength—Pressure castings more accurate but of uneven structure—Speed of production important factor

SO MUCH is written on the extreme accuracy of die-castings, and so much of that is exaggerated, that a word of warning will not be out of place. It is true that many millions of aluminum die-castings are produced having a degree of accuracy quite unobtainable on sand-castings, and entirely adequate for the job in hand without any machining whatever. However, the time is not yet when parts like the crankcases of aëroplane engines or the breech-blocks of naval guns can be cast dead to gage, with all holes, screw threads, and oil-ways ready for assembly.

There is one obstacle to absolute accuracy which is not very widely appreciated, and that is the contraction which takes place in the casting after it is taken from the mould—a contraction which may be calculated to a nicety in the case of a solid straight test-bar, but which tends to vary throughout the different sections of an intricate casting. This factor gives rise to minor distortions in the casting on cooling, which are difficult either to foresee or to counteract, and which are unaffected by the most accurate work in making the die.

The casting of screw threads is yet another point. Most customers tend to press for this feature, without considering that the removal of a threaded core may double or treble the time of production of any one casting, and introduce all sorts of complications in a casting which should be removable in a few seconds. The cost of this is almost invariably more than that of a rapid tapping operation in a hole already cast to tapping size, and the extra cost inevitably comes on the customer.

Die-casting in any of its approved forms can be guaranteed to save a great deal of costly machining and finishing, and in a great number of applications it cuts out all operations other than mere assembly. The process has its limitations, however, just like any other. It can never entirely supplant sand-casting in general engineering, nor can it yet attain the precision of a machined part on any but small and simple pieces. A due recognition of these present limitations will assist to an intelligent development of the undoubted economical potentialities of die-casting as generally applied to manufacturing.

Extracts from a paper presented before the Institute of Metals, London, March 11.

Comparison of the relative merits of pressure and gravity die-casting, and reasons why American quantity production favors the pressure method, while British manufacturers retain the gravity mold for die-casting

Of the five classic methods of die casting we may reject three. Slush casting is not an engineering process, though a useful and economical string to one's bow in the case of decorative parts. Centrifugal casting is supreme in its distinct field, but this is necessarily a limited one. The Cothias process, economical and accurate enough, is confined by its very nature to castings of relatively open shape. There remain the gravity and the pressure systems, and the choice between one or the other depends on a variety of factors, which may conveniently be considered under the broad headings of technical and economical aspects.

It seems on the face of it that the pressure casting must logically be the sounder—that since an ordinary gravity poured casting is stronger than a sand-casting, one poured under pressure must necessarily be stronger than either. This is a point of view so often encountered, and so fundamentally wrong, that a brief consideration of the factors which make for soundness in a casting may be justified. For the fact is that a gravity poured casting is superior in metallurgical structure than one produced by the pressure machine. The reasons for this are in the total shrinkage of the metal and its propensity to absorb gases, making it in reality sounder than the pressure casting.

In the case of a gravity mould, the relative temperatures of metal and mould, and the rate and the direction of pouring may be so regulated that the casting freezes more or less progressively as the mould slowly fills. Each layer as it freezes can be automatically fed by the fluid layer above, and this factor can do much to counteract any evil effect of crystallization shrinkage on the strength of the subsequent casting. Contrast this freedom of pouring and these elastic conditions with the case where the metal is shot into the mould and instantly solidified while still in a turbulent condition. In both cases the metal in contact with the walls of the mould freezes first. But in pressure casting there is little to feed the space between what are in reality two thin castings, one within the other, and as a consequence the space between sets to an open, porous structure within a beautifully finished exterior with a core of indifferent strength.

Similarly in regard to gas occlusion. In both gravity and pressure casting practice the tendency is for the

metal to absorb rather more gas than would be accepted as good practice in a sand foundry. The pressure system tends if anything to encourage such absorption by reason of the air pressure applied periodically to the surface of the melt.

The air within the mould is taken care of in both instances by the provision of adequate vents. The latitude in gating and pouring offered by the gravity system necessarily implies a more thorough escape of this air as compared with the high velocity entry of the metal under artificial pressure, but this is an aspect which may well be overcome by ingenuity in design of the pressure die.

The most careful venting, however, will not help matters in regard to the gases occluded within the metal itself. These gases tend only to leave the metal as it freezes, and by that time every vent in a pressure die is effectually sealed by a thin but relatively impervious wall of solidified alloy, so that the gases remain within the casting. In the case of a correctly poured gravity casting gases have more time to come off progressively at the rising surface. This is indicated by the marked difference in the fracture of such castings as compared with those from pressure machines.

Two Distinct Fields

The question naturally arises as to why, if this is so, pressure castings are turned out at the rate of many millions daily; so much so that the tonnage from one or two large firms in America alone equals the tonnage produced by most of the gravity mould founders in England. The reply is that for a vast range of industrial parts academic considerations of strength simply do not count. All that is aimed at is a light, rigid part, of adequate strength for the job in hand, and calling for little or no subsequent work. This is just what is offered by the pressure casting, no more, and no less.

Technically speaking, gravity and pressure castings cater for two quite distinct fields in industry, although these fields necessarily overlap to a considerable extent. On stressed work gravity casting comes into its own; but for many thousands of parts pressure casting is pre-eminently suited on the grounds of economy, rapid production, adequate strength, and a degree of consistent accuracy which cannot be maintained in a gravity mould. Where considerations of strength are subservient to these considerations, the only factor which need be considered in the choice between the two systems is the number required regularly from any one mould. Gravity castings, when gated and poured, have preference to sand castings of the same alloy.

Economically the pressure system starts with a heavy advantage in speed, accuracy, and the possibility of running thinner sections than are practical in a gravity mould. It is economical in labor because most of the operations are effected by mechanical means, and in metal because both gates and actual sections of the castings are cut to a degree impossible when working only with gravity.

These advantages, however, are not obtained for nothing. The whole value of pressure casting depends on the handling of a sufficient number of castings of one design to warrant a heavy initial outlay. Pressure casting machines are costly; and in addition to these must be added the capital cost of a well-equipped machine-shop on tool-room lines, for the production and maintenance of the necessary dies. These dies are in themselves exquisite pieces of mechanism, designed and constructed by experts, built up of sections and cores and slides of special alloy steels. These steels, selected with care by metallurgists, are heat-treated more than once in the process of manufacture, and tested again and again for minor flaws and cracks which may cancel much costly workmanship when subjected to the searching action of molten aluminum under pressure.

Against this the ordinary gravity mould, cast of close-grained grey iron, finished in any average machine shop to dimensions given on a rough sketch, is a simple matter. Such a mould often costs little more than a set of first-class patterns and core boxes, and may cost less than metal patterns and stripping plates arranged on a machine for an equivalent output in sand moulding of the same kind of work.

There is, in fact, little room for comparison between the outlay on a gravity mould and that on the highly developed die of a pressure machine. The former is justified on orders for a few hundreds. For the same casting a pressure die would seldom be justified for orders of as many thousands, whilst the great pressure die-casting industries were in fact largely built up on orders running into the region of millions of castings from one fixed design.

It is mainly for this reason that we in England, lacking the demand for castings in vast numbers to one design, have tended to develop the undoubted usefulness of the simple gravity mould, while Americans, with their immense internal markets and their genius for quantity production, have brought the process of pressure casting to a very high art.

Design Estimating

By John F. Hardecker

"Well, Bill," said Jack Smith cheerfully to his fellow chief draftsman at lunch, "I certainly had a good break this morning. You know we are installing the heavy machinery in that big factory the Columbia Co. is building down at the river front. Due to a slight modification to one of our machines, I had to send one of our draftsmen down there to check for clearances. When he returned, he reported that the flooring under it looked very weak. A hasty calculation showed that there was good reason for his suspicion, and I called up one of the executives of the Columbia Co. and reported it to him. Just before I left, he phoned back with profuse apologies and admitted the error, since we had given all the necessary specifications for the loadings of the machines."

"Yes," agreed Bill, "you certainly were fortunate to have sent such an exceptionally good man out there, for surely the average man would never have noticed it." "On the contrary," replied Jack, "I really believe any other of our men would have found it. You see, I've made a point of having our design men estimate a member before they calculate for it. This method not only puts a sporting interest in their work, but also makes a sort of game out of routine calculations. It develops their self-confidence, and puts a real check on the results of their calculations. If they have made a gross error of the usual decimal point type, it is immediately apparent. In fact, I have a few men developed to the point that the necessary time for calculations in estimating a job is cut in half."

THE MACHINE
the emblem of progress

By LORING ROPER

Out of past ages of struggle
to wrest an existence, no more,
We have come to a standard of living
that never was dreamed of before.
For beginning with Watt and his engine,
we have made steam a servant and slave,
We have lightened the tasks of the nations,
we have forced it our labor to save.
'Till today, in an hour, man produces
more wealth by the use of machines,
More comforts, for homes of the humblest,
than graced the abodes of past queens.

We have made massive cranes do our lifting,
huge tractors now plow in our fields,
So that fewer men now do our farming,
yet each is increasing his yields.
We count motor cars by the millions,
with workers enjoying their share,
There are aeroplanes too, for the daring,
for quick, easy travel by air.
And all of our many advances,
each making life better for all,
Have come from machine-made devices
that answer some need, great or small.

But in spite of our gains and our freedom
from back-aching labor and pain,
We find some bemoaning the changes,
who are calling for hand work again.
'Tis true that the early day changes,
the shift from the man to machine,
Caused hardship to hundreds of workers
whose plight should have long been foreseen.
But in spite of mistakes in the changing,
in spite of the confines of shop,
The worker was helped by the changes,
would suffer the most should they stop.

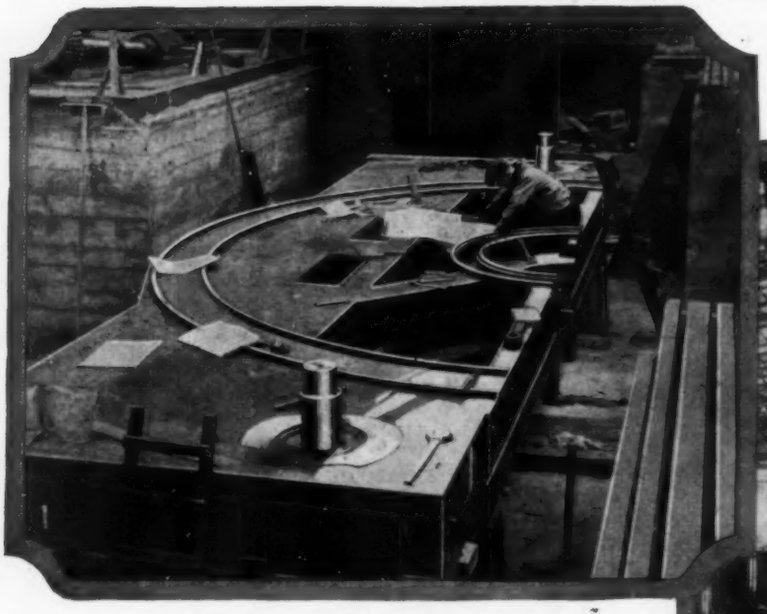
'Tis true he is part of the routine,
his work must conform to the rest,
He cannot change shape or dimension,
to suit what he thinks is the best.
For whenever men labor together,
no matter the work or the way,
They must follow a plan for the product,
lest the things we have gained go astray.
And to the machine and its methods,
devices that save brain and brawn,
We owe our high standard of living—
their value cannot be o'erdrawn.

Without them our progress would falter,
no longer the hand worker's way
Can produce enough things for our markets,
at a cost that the user can pay.
And the man in the shop is much freer,
than ever was worker before,
Though he be but a part of the routine,
that daily adds much to our store.
For his hours have appreciably shortened,
machines save him bodily tire,
And his share of the products of business,
is growing increasingly higher.

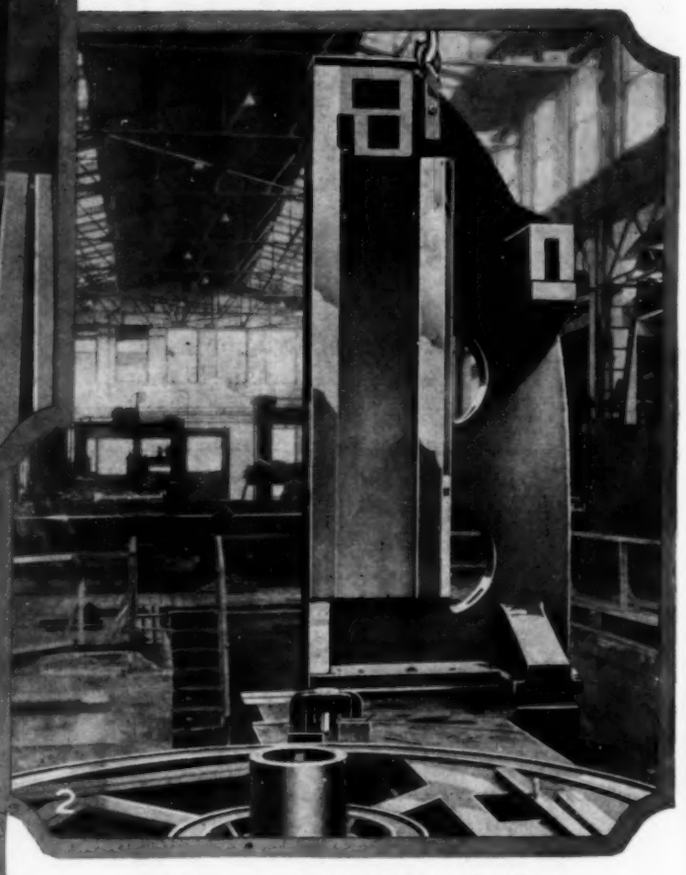
* * * *

So let us be done with the notion
that machines make a slave of the man,
'Tis machines that are easing his labor,
they are part of the betterment plan
That will give all more comfort and leisure,
more joys as we journey through life,
When we work out harmonious methods,
that'll give each his share, without strife.

Steps in Assembling

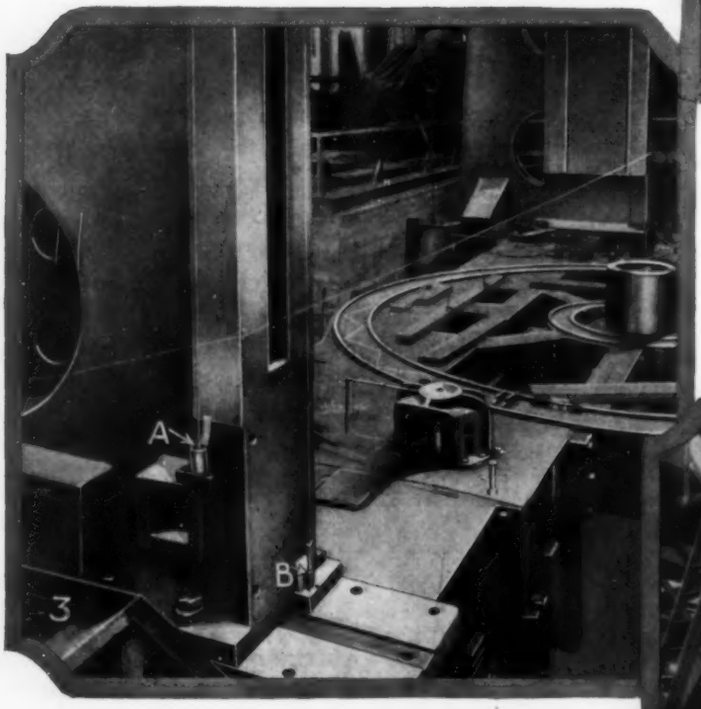


1—Assembling feed drive in main section of bed

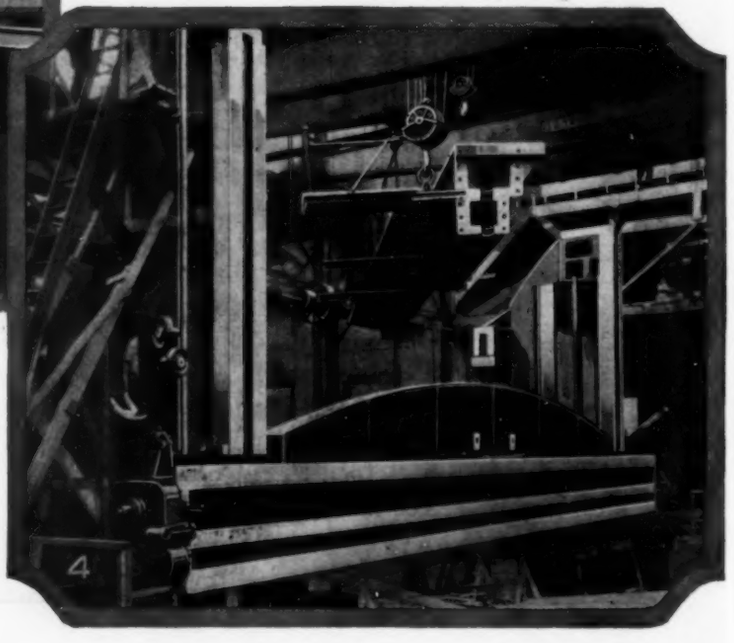


2—Putting one of the housings in place

Photographs from the Bertram Works, by

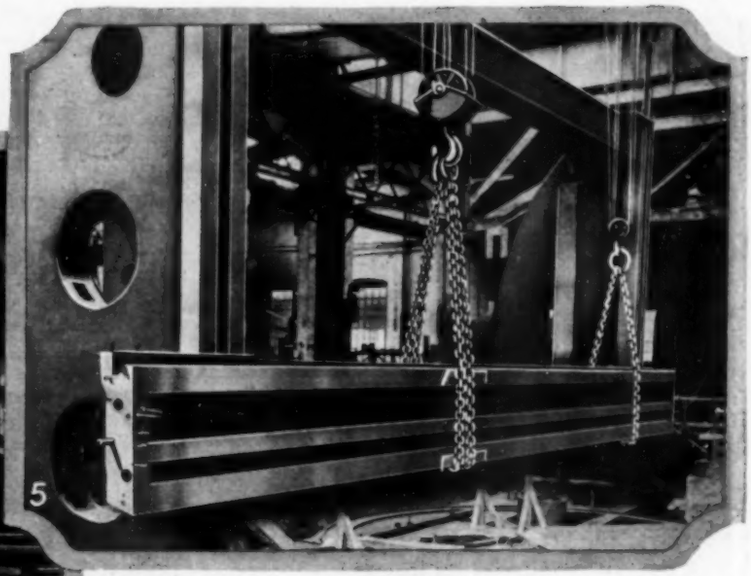


3—Lining-up housings. Note plumb-bobs at A and B

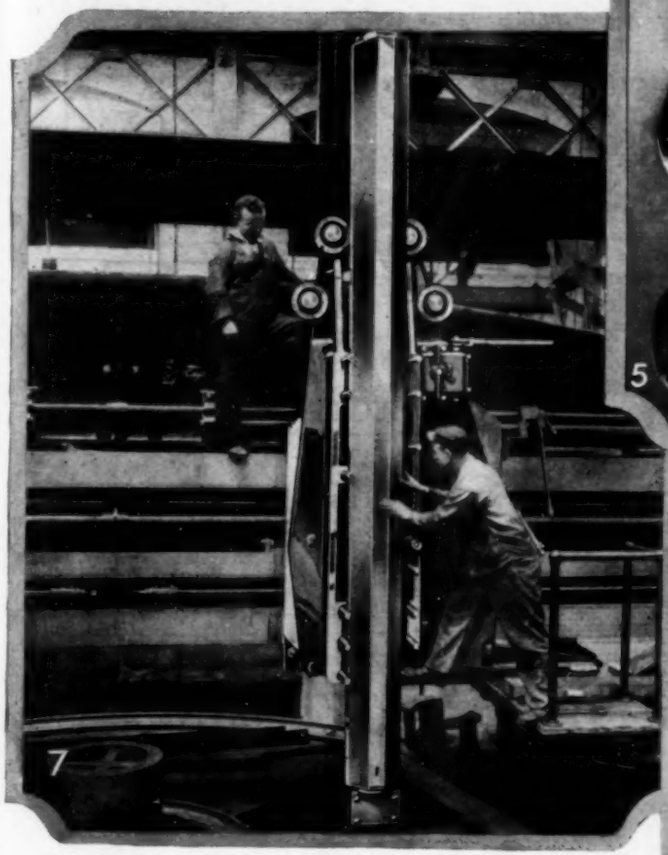


4—Assembling top bridge and foot-walk

a 36-Ft. Boring Mill

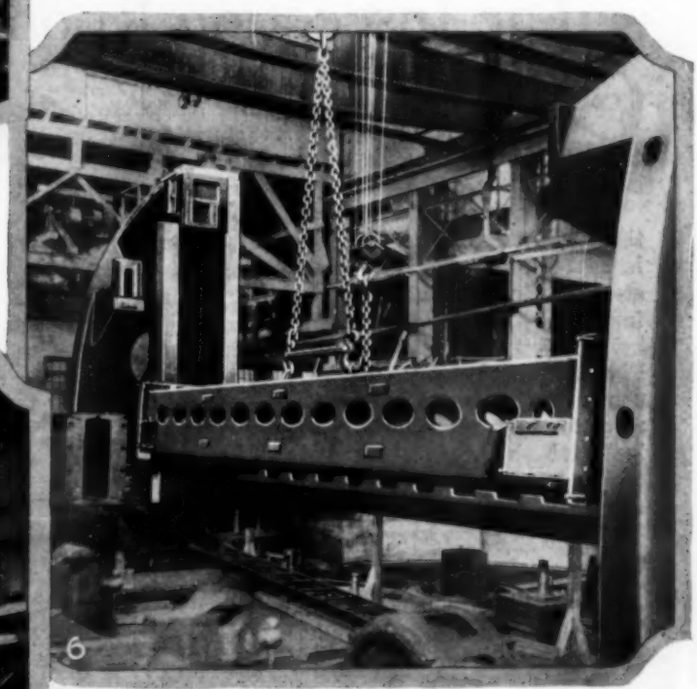


5—Putting the cross-rail in position

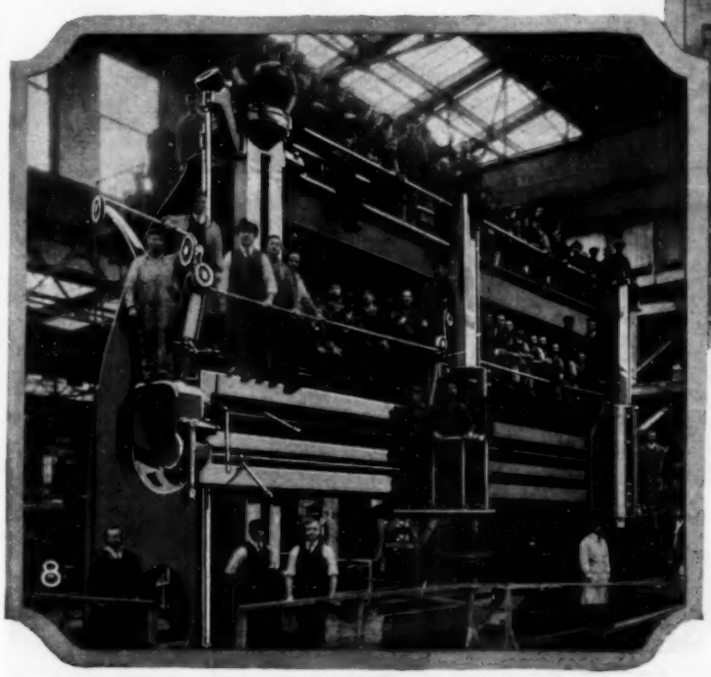


7—Getting the boring bar in position in the head

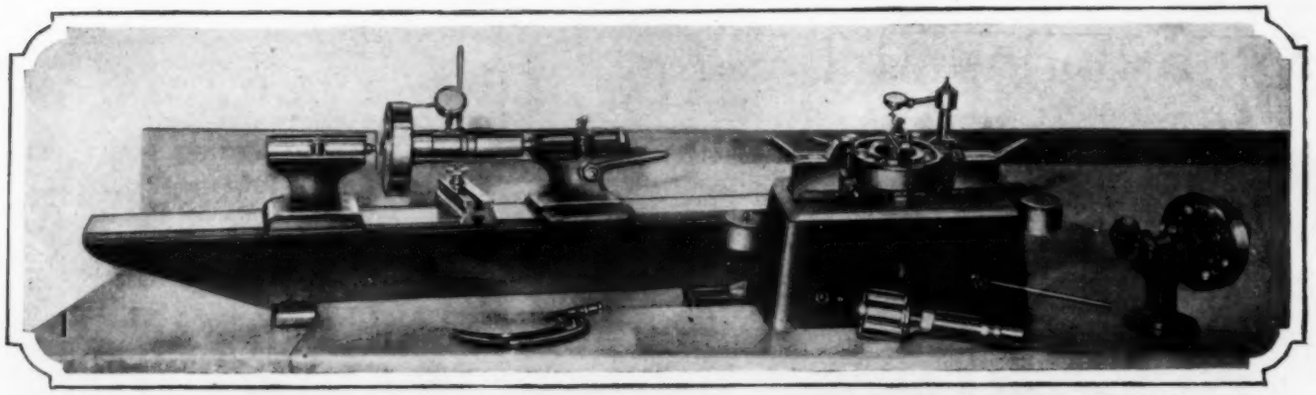
courtesy of the Niles-Bement-Pond Co.

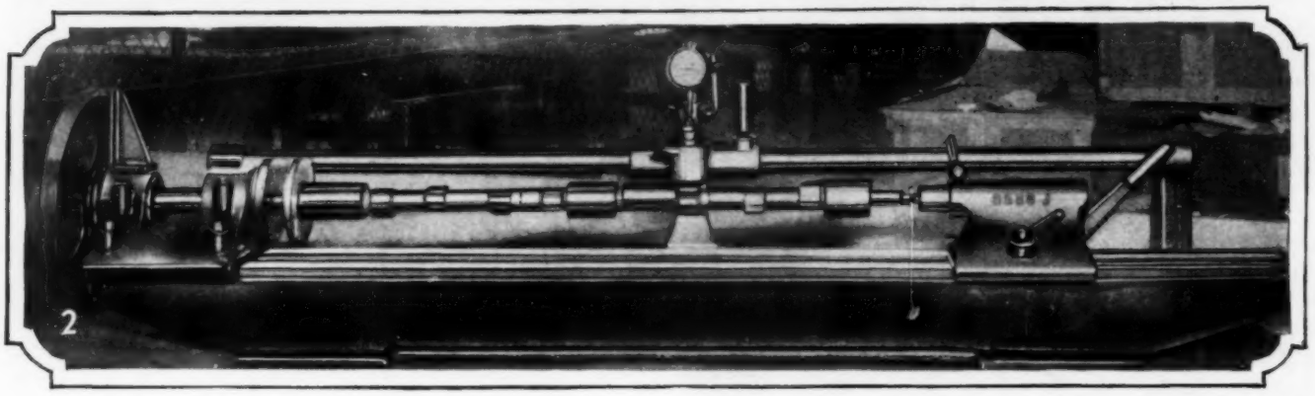


6—Assembling back section of cross-rail



8—The completed boring mill





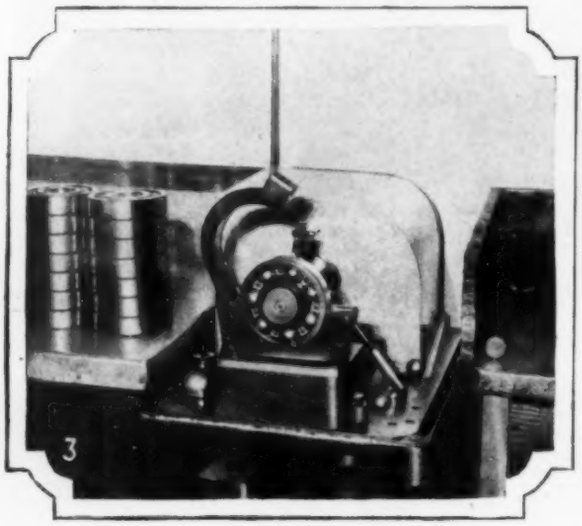
The Inspection Room in a Truck Plant

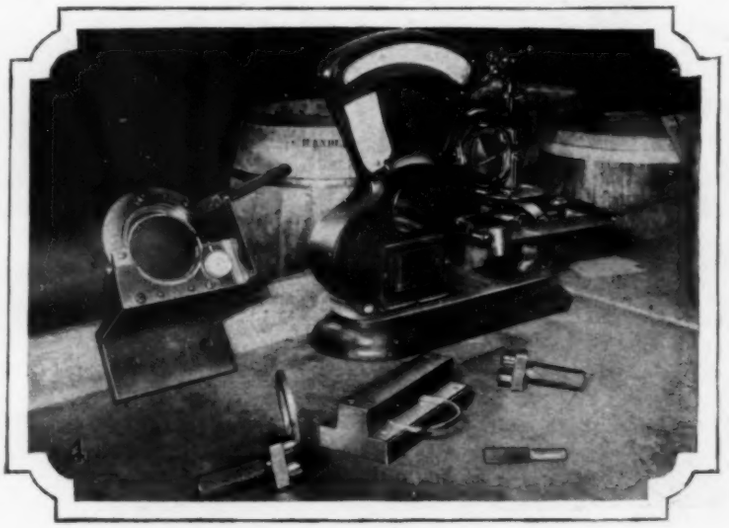
CAREFUL inspection is one of the keynotes of a satisfactory product. The White Motor Co. uses numerous ball bearings and tests them in various ways. In Fig. 1, at the left, a bearing is being tested for concentricity and "wabble," while at the right is a device that tests the various functions. The bore of the inner race is measured by the Bath inside micrometer in the stand at the right, another micrometer being shown in front of the test instrument.

The method of testing camshafts is shown in Fig. 2. The index plate at the left indicates the points at which the different cams function. The amount of lift of each cam is measured by the dial indicator shown in the center. The indicator is mounted on a rod and can readily be moved from one cam to another.

A running test stand for ball bearings is shown in Fig. 3, while in Fig. 4 the testing of piston rings is illustrated. The dial on the fixture at the left, indicates the amount of opening in the ring when it is compressed to the diameter of the cylinder. The scale at the right is fitted with an atttachment for holding the ring in its compressed position, and is so connected to the scale as to permit the tension to be weighed.

The various gages seen in the foreground are for testing, respectively, the thickness, the width, and the opening of the slot when the ring has been allowed to assume its open position.





The Design of Gear Tooth Forms

By Earle Buckingham
Associate Professor of Engineering Standards and Measurements
Massachusetts Institute of Technology

The form milling of gears and the action of gears produced by this method—Effect of eccentricity—Effect of errors in milling

THE 14½-deg. composite system was developed for formed milling cutters, but there is no reason why it cannot be produced by generating methods, if desired. When a generating method is employed, the generating cutter must take the form of the corresponding gear or of the basic rack of the system.

Form milling of gears is the most widely used method of producing gears today, and probably always will be. This does not mean that more gears are produced by

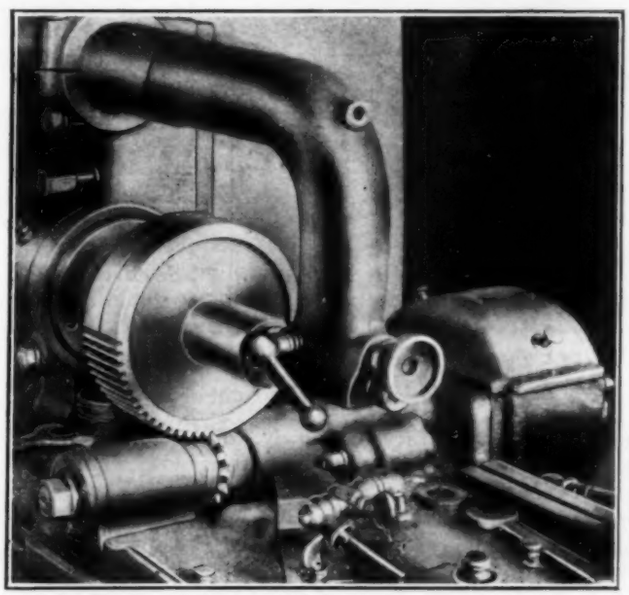


Fig. 42—Cutting of a gear blank by form milling

form milling than by other methods, but rather that form milling is employed in more places than are other methods. This is because by form milling gears can be made without any other special equipment than the form-milling cutters. For general jobbing and repair work, a standard milling machine equipped with an indexing head or a dividing head is all that is required.

This method also lends itself readily to the production of gears in quantity. Standard gear cutting machines are on the market for milling gears. These are made in many types. Some have single work arbors, while others have several and thus cut several gears or stacks of gears at the same time. All of these machines are automatic. Fig. 42 shows a representative gear cutting machine of this type with a single work arbor.

The tenth article. The eleventh article will appear in an early issue.

The milling cutters are form cutters relieved so that they can be sharpened by grinding the face of the cutter tooth without losing their form. Such a cutter is shown in Fig. 43.

Theoretically, a different cutter is required for each gear of a different number of teeth. A series of cutters has been developed, however, for the 14½-deg. standard tooth forms so that only eight cutters are required for each pitch. These are adapted to cut from a pinion of twelve teeth to a rack.

No. 1 cutter will produce gears from 135 teeth to a rack
No. 2 cutter will produce gears from 55 teeth to 134 teeth
No. 3 cutter will produce gears from 35 teeth to 54 teeth
No. 4 cutter will produce gears from 26 teeth to 34 teeth
No. 5 cutter will produce gears from 21 teeth to 25 teeth
No. 6 cutter will produce gears from 17 teeth to 20 teeth
No. 7 cutter will produce gears from 14 teeth to 16 teeth
No. 8 cutter will produce gears from 12 teeth to 13 teeth.

These cutters are usually made of correct form for gears of the smallest number of teeth in their range. Thus a No. 5 cutter is correct for 21 teeth and approximates very closely the form for the others in the range. These cutters are satisfactory where the conditions, which the gears must meet, are not severe. For more exacting gears, cutters of the half numbers listed above are made as follows:

No. 1½ cutter will produce gears from 80 teeth to 134 teeth
No. 2½ cutter will produce gears from 42 teeth to 54 teeth
No. 3½ cutter will produce gears from 30 teeth to 34 teeth
No. 4½ cutter will produce gears from 23 teeth to 25 teeth
No. 5½ cutter will produce gears from 19 teeth to 20 teeth
No. 6½ cutter will produce gears from 15 teeth to 16 teeth
No. 7½ cutter will produce gears with 13 teeth.

Special cutters are also made of correct form for any tooth numbers and any pressure angle and tooth form. This is an expense that is often justified for the production of large quantities of duplicate gears.

Great care must be exercised in setting up a milling machine to cut gears, if reasonably accurate results are desired. The center of the cutter must be accurately aligned with the center of the blank. For this reason, form cutters often have a line graved on them to locate the center of the cutter profile. The cutter must also be set closely to the proper depth. In fact, any mislocation from the correct relative positions of the cutter and gear blanks is a source of trouble.

Analysis of Milled Gears*

As noted before, theoretically a cutter that is correct for a certain number of teeth is incorrect for any other number. Practically, however, this error is slight. Furthermore, this theoretical error can be largely compensated for by adjusting the setting of the cutter.

Again, it often happens that a gear with 23 teeth, for example, is required, while the nearest cutter available is the No. 4 cutter instead of the No. 5 cutter which is ordinarily used. The No. 4 cutter can be used with good results by slightly modifying the depth of cut.

Furthermore, it is often desirable to provide more backlash on the gears than is present when the gears are milled to the theoretical depth. This is accomplished by sinking the cutters deeper into the blanks. Theoretically, this displaces the profile and alters the gear tooth action. These errors also can be largely compensated for by a suitable adjustment in the depths of cut.

A study of the errors introduced by the foregoing factors will show that they can be reduced and compared to the errors in eccentric gears. The analysis, itself, is involved and requires much study to follow. It is omitted for several reasons. In the first place, the space available is not sufficient to make a clear and complete exposition of the subject. In the second place, the majority of us are not so much interested in the derivation of the various equations as we are in the equations themselves, and in their practical application. While in the third place, the inclusion of the involved derivations would tend to obscure the simplicity of the final results.

Eccentric Gears

An analysis will show that, if an eccentric involute gear, driving a rack, turns uniformly about its axis of rotation, the velocity of the rack will fluctuate according to a pure sine curve. This holds true for any amount of eccentricity.

If an eccentric gear, driving a concentric gear, turns uniformly about its axis of rotation, the velocity of the concentric gear will fluctuate almost according to a sine curve. When the amount of eccentricity is small, and we are dealing only with relatively small errors in this analysis, the variation from the sine curve is so slight that it can be neglected.

If an eccentric gear drives another eccentric gear, the velocity of the driven gear will fluctuate according to two sine curves. If the tooth numbers and the amount of eccentricity are alike on both gears, they may fully compensate for each other. When the tooth numbers are alike, but the amount of eccentricity is different, they can be made to partly compensate for each other. In other words, the resulting error will be the same as if only one gear was eccentric with an error equal to the difference in eccentricity. When the tooth numbers are different, they cannot, as a rule, compensate for each other.

*Ernest Wildhaber, page 757, Vol. 59, *American Machinist*.

Purely eccentric gears, with small or large eccentricity, give a varying but continuous action. Each succeeding tooth takes over the load from the preceding one smoothly, without impact. This smoothness of action requires, of course, a sufficiently large angle of contact, a condition which is also necessary for smooth-running concentric gears. Furthermore the tooth load should be large enough to keep the teeth of the two gears in contact.

Error When Milling Too Deep

When a cutter is set to cut deeper than the theoretical depth, the tooth profiles of the cutter no longer correspond to the center of rotation of the blank; the center of the profile of each tooth space is then located beyond the actual center of the gear blank. This causes a somewhat different action than pure eccentricity because, instead of having one center of eccentricity, each tooth space now has its own center of eccentricity. It is quite common in practice to cut too deep. This procedure introduces the required play or backlash into the gears in order to avoid jamming. The effect of cutting too deep is to give a variable and a slower motion to the driven gear. Such a gear will move its rack too slowly. The following tooth comes into action too early and with a blow. This premature contact is also edge contact, as the tip edge of the rack does not contact tangentially with the flank of the pinion tooth, but is somewhat tilted. The pressure is thus transmitted through the edge as long as the tip edge of the rack and the flank of the pinion tooth stand up. Such edge contact is dangerous and should be avoided.

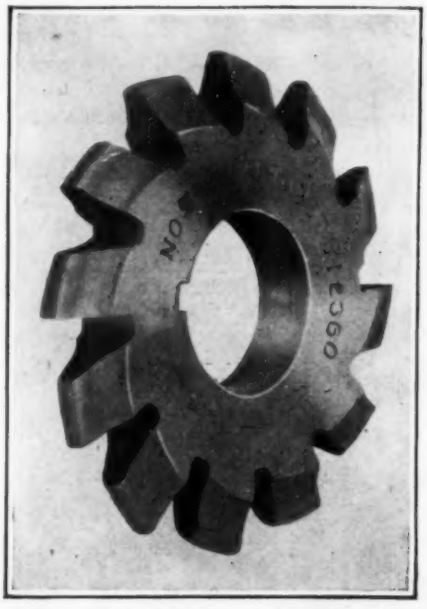


Fig. 43—Typical form milling cutter for gear teeth

The same relation as for a rack drive holds substantially true for gear drives, where one gear, which is cut too deep, meshes with another correctly cut gear. If the driver is cut too deep, then the driven gear has a tendency to fall back, and the contact on every tooth will start with edge contact. On the other hand, if the driven gear is cut too deep, while those of the driver are cut to correct depth, then the driven gear has the tendency to advance. This contact will also start with a blow, but with one which is reduced as compared with the previous case because of the momentum of the moving parts. Moreover, there is no edge contact. The contact does not start at the bottom of the active face of the driving tooth and the tip of the driven tooth, but starts somewhat above the bottom of the active profile of the driving tooth and below the tip of the driven tooth.

The influence of cutting deeper is dependent upon the

number of teeth in the particular gears. Pinions with small tooth numbers are much more sensitive than gears with large tooth numbers. The amount of falling back or advancing of the driven gear is inversely proportional to the number of teeth in the gear which has been cut to a given excess depth. In other words, if in different drives, one gear is always cut to an excess depth which is proportional to its tooth number, then all these drives will contain the same error.

The foregoing refers to the cutting of one gear of a drive too deep while its mating gear is cut to the correct depth, and to the using of cutters corresponding to the exact number of teeth in the gears. By cutting both gears of a drive too deep the error may be partly or even entirely compensated for. If two gears are cut with cutters that correspond to their exact tooth numbers, but are cut to an excess depth proportional to their respective tooth numbers, the errors will then just compensate for each other.

Action of Gears Cut with Formed Cutters Corresponding to Different Tooth Numbers

The milling of gears with different cutters than those which correspond to their exact tooth numbers, has two effects. First, it produces a certain drop in the velocity of the driven gear from the beginning to the end of contact. Second, it tends to shift the period of contact ahead; that is, the contact will start at or near the bottom of the active profile on the driver, but will end before it reaches the top of the driving tooth.

In such gears only one tooth can be in contact at a time. In other words, the duration of contact of any one tooth lasts for one tooth interval and no longer. If the tooth profiles are long enough to provide this mesh, this drawback is not very important. If the tooth profiles are not long enough, however, edge contact will occur. The tooth profiles of the 14½-deg. composite system are sufficiently long to avoid this condition.

Improving Drives

We have it in our power, however, to make a considerable improvement in the action of these gears by making one error, such as results from using a range cutter, compensate to a large extent for another, such as cutting the teeth deeper. In this way we can force the contact towards the middle of the mesh and always avoid edge contact. At the same time we can always introduce the desired amount of backlash safely.

Psychology on the Rush Job

By J. Homewood

We have all, some time or another, had the experience of doing a job under great stress of time. Everyone is familiar with the time worn phrase, "They are in a great hurry for this; get it out as soon as you can." Time and again have I seen a workman "work his fool head off" in order to get the job out of the way, only to have the thing repose inactive on the foreman's desk from ten minutes to ten hours. To a conscientious workman this procedure is humiliating. The least the foreman can do is to hide the job, after it is finished, if something unforeseen happens to necessitate its retention from service. A rush job, coming from the workman's hands, being left to cool off right before his very eyes, is bad psychology, and lays the foundation for less effort at some future time. Use tact, Mr. Foreman, get the job out of the way.

Methods—Who Starts Them

By Joseph W. Meadowcroft

After a workman has been on the same job, using the same method for a number of years, his work becomes automatic, and is done at a rate of speed that cannot be equaled by any other operator whom the foreman or superintendent may select, unless the new operator has had an almost equal term of experience. After reaching this point, both foreman and operator may feel satisfied with what has been accomplished. But this is not the proper stand to take. Scientific time study may show the method assigned to the operations may be satisfactory. But on the other hand, the time study man, in checking the operations closely, often discovers he can change the method of operation, thereby increasing production, reducing cost of the product, and making the operation much more simple for the operator. The shop moral is that suggestion changes of this character should not wait on the time study men, alone, but should be made by the foreman, gang foreman, mechanic, and operator.

Mechanics as Inspectors

It is also of vital importance that individuals supervising the output of any commodity be thoroughly familiar with the methods used, so that an economical product of the very highest quality may be produced. This factor of quality of product is generally left to the inspector, and for this reason I advocate the selection of inspectors who have had more or less training in methods, and who are capable of performing any operation on any piece they may be assigned to inspect. By selecting inspectors in this manner, and having them at certain times make inspections of the operations as they are being done in sequence, instead of waiting until the article is finished, the product will be held to a high standard. This inspection also assists the operator to become more efficient in producing quantity as well as quality, for the inspector will see to it that the workman is provided with every possible facility for the quick handling of the parts.

Also, permit me to stress this most vital item concerning methods. Regarding cost—it is much more satisfactory to change methods to reduce costs than to continually change prices, as was done years ago. Therefore, we must continually improve our methods and entertain any suggestion made by the employees, whether they can be used or not. I have known of factories where suggestions by the employees were not even considered; consequently the workmen were only interested in the original method which they were using, and there was no further progress. We must have progress, and the best method to accomplish this is to interest employees so that they are loyal, take an active interest in their work, have pride and conscience in everything they do, and to endeavor, in every way possible, to make them feel that they may even become executives of the company. From the workman's standpoint if he has made a suggestion for a change in the method of procedure, and it is not accepted and used immediately, he must not allow his spirits to be dampened. Failure to incorporate suggested changes may not lie with his immediate superiors, but may be due to sales or finance objections, or to many and varied conditions.

Ideas from Practical Men

A Lathe Adapted to Turn Radii

By Milton Wright

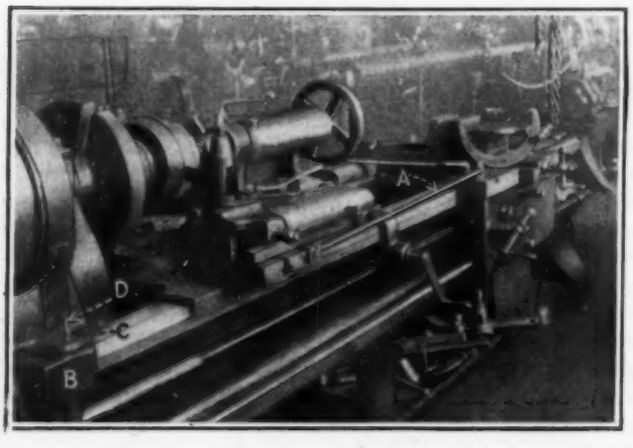
A manufacturing concern that has occasion to turn many hundreds of ball bushings to a definite diameter and spherical radius, has adapted a standard engine lathe to the purpose by the simple expedient here shown.

In place of the carriage there is a bridge, fitted to the lathe shears and held in a fixed position by clamping it to the bed. Swiveling upon this bridge is a part somewhat different in appearance but identical in principle with an ordinary compound rest. There is no main cross-slide, however, and the center of swing of the swiveling member is in a vertical plane with the center line of the lathe. The compound rest provides ample range of crosswise adjustment to obtain different diameters and radii.

When setting up the lathe for the job, the tailstock is lifted and the regular carriage traversed to the rear end of the bed. The tailstock is then restored to position, the attachment placed on the shears between the head and tailstocks, and adjusted so that the center of swing is midway of the length of the bushing to be turned. The bridge is then clamped to the shears, its position remaining fixed throughout the job.

A reach-rod *A* joins the swiveling member to a stud set in the nearer wing of the carriage. The circular-feed movement is, of course, provided by the regular feeding mechanism of the lathe and carriage, the full range being available.

The same attachment is also provided with a special power cross-feed, derived from the leadscrew through a pair of miter gears carried in the lower end of the bracket *B*, which can be clamped to the outer shear in whatever longitudinal position may be required. The lower one of the pair of miters is splined to the lead screw to make endwise adjustment possible. The connection between the crank-disk *C* and the cross-slide is not in position in this picture, but may readily be understood.



Lathe rigged for radius turning

On the outer end of the screw of the compound rest, is keyed a small ratchet. By removing the nut at the end of the screw a small lever, carrying a pawl, may be slipped over the projecting portion of the screw, on which it is retained by the nut, the pawl engaging with the ratchet. The free end of the pawl lever is connected by a reach-rod to the pin *D* in the crank-disk before mentioned.

Universal joints in the reach-rod allow for varying angularity in the connection. A facing cut can be made at any reasonable angle by setting the swiveling member to the desired degree, and at any rate of feed within the range of the screw-cutting train of change gears. Thus the device serves two purposes.

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

Pouring Babbitt-Metal Bearings

By L. D. Allen

I recently visited a plant where considerable trouble had been experienced with pitted and cracked liners of babbitt-metal bearings and with the shrinkage of the liner from the mandrel. It was thought that the pitted surfaces were due to the presence of dirt in the metal. I was able to prove, however, that the pitted surfaces were not caused by dirt pockets but by blow holes, where air had been pocketed as a result of the wrong method of pouring the metal at an incorrect temperature.

When pouring small bearings, the trouble was remedied by warming the mandrel and the backing and flushing the metal quickly at a temperature of about 750 deg. Fahrenheit.

The large bearings had been poured in an upright position and had pocketed the air because of the swirl and splash of the metal dropping to the bottom of the bearing. The liner had crashed under load and vibration, not because of these air pockets but because of seams produced by pouring the bearing in batches. The ladle was not large enough to hold all the metal needed to fill the bearing, consequently about half the bearing was poured at one time, followed by the pouring of the second half. The first half had set, of course, before the second half could be poured and the two casts did not thoroughly combine. The method of correcting this trouble is obvious. The ladle must be large enough to contain all the metal in one pour.

To avoid air pockets in large upright bearings it is necessary to pour the babbitt metal from the bottom by means of special devices designed to fit the particular

job. By using this method, the metal enters the bearing at the bottom and rises to the top, forcing the air ahead without tending to enclose it. A solid bearing results.

Both the mandrel and the backing became hot from the presence of the molten metal, but the temperature of the latter was lower than that of the former because of more favorable radiation. As a result the mandrel shrunk to its normal size upon cooling and left the liner with a bore equal to the expanded diameter of the mandrel; this was too large. The solution was to provide water cooling of the mandrel.

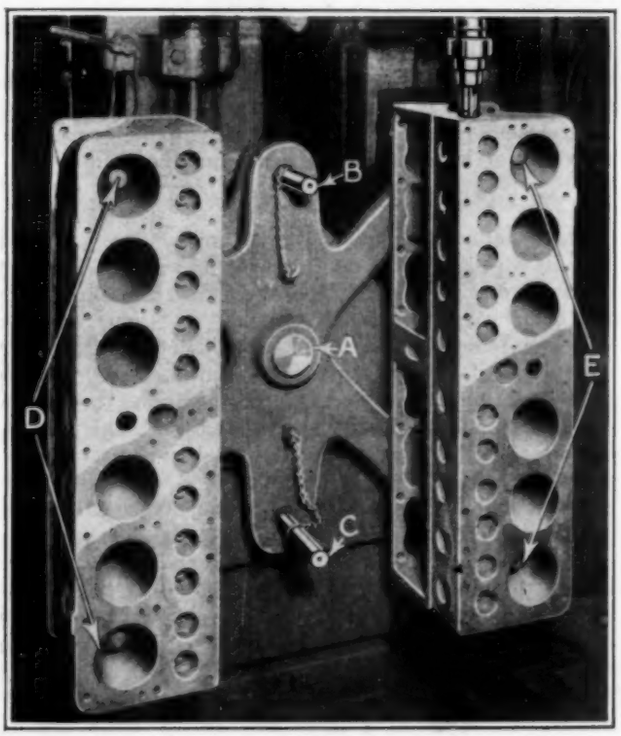
In the example given the babbitt metal was of a lead base. Tin-base metals should be poured at a temperature ranging between 800 and 900 deg. F. depending upon the thickness of the liner and the depth of the pouring area.

A Double, Balanced Fixture

By Frank C. Hudson

In handling large pieces of work, the labor will be lessened if the loaded fixture can be fairly balanced, even if not accurately. It saves much lifting by the operator and also tends to secure safety, since unbalanced work has a way of suddenly tipping or twisting in the wrong direction.

The illustration shows two cylinder blocks of the larger six-cylinder engine built by the Cleveland Automobile Co., on a fixture used in counterboring the holes



Handy fixture for counterboring water plug holes

for the welch, or core-opening plugs, at different places on the block. The work is done on a radial drill.

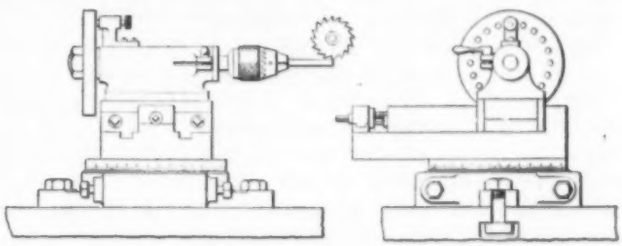
The fixture can be turned on the center bearing *A* and locked in four positions by the pins *B* and *C*, which are fastened by chains to prevent them from being mislaid. The two cylinder blocks are held by being slipped over projections *D,D* and *E,E* that fit the end cylinder bores closely enough to prevent undue movement during the counterboring operation.

A Simple Dividing Head

By C. Homewood

It is well known that the most expensive part of a universal milling machine is the dividing head, owing to the unusual amount of labor and skill expended in making this particular part as accurately as possible. Therefore, the dividing head should be used only when necessary, since it is classed as a precision machine in itself, and should be treated with the utmost care in order to preserve its accuracy as long as possible.

With that object in view the writer has designed a small dividing head similar to the one shown in the



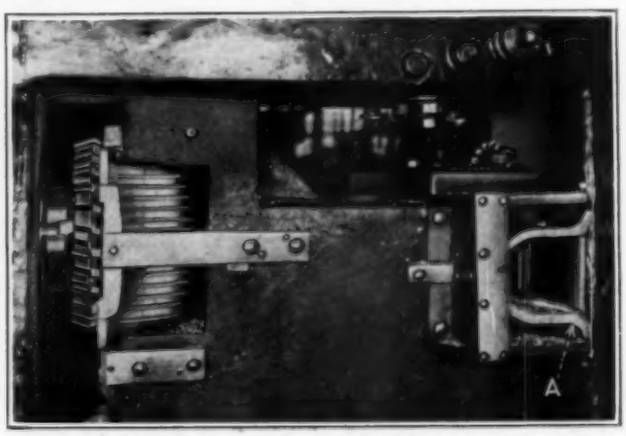
Home-made dividing head

accompanying sketch. Its general handiness can be seen at a glance, since it is made to be clamped in the jaws of the milling-machine vise. It is very light in weight as compared with the regular dividing head, and can be set to any desired angle in a horizontal plane by using the graduations on the vise. Of course, the number of divisions that can be obtained with this head are very limited and it is not recommended for extremely accurate work. However, it should prove a big time saver on little jobs, such as can be held in a collet or in a three-jawed chuck.

Milling Two Jobs at Once

By Clifford H. French

A combination milling operation, of oil pan and valve cover, is shown herewith. In the combined operation, the side heads of a large Ingersoll machine are used, each head surfacing a different piece as can be seen.



Double fixture for facing two jobs

The fixture was designed to utilize the machine to the best advantage for the output desired. The main problem was to hold the light aluminum castings without springing them and to support the flange of the casting at *A* against the spring due to the thrust of the cutter.

How to Fit Shims in Bearings

By George G. McVicker

When adjusting the shaft bearings of an internal combustion motor or similar machine, it is quite as important that the shims between the cap and the body of the bearing be fitted correctly, as that the shaft be properly fitted to the bearings.

It is customary for the factory that builds the motor to use shims of different thicknesses, usually two or three, in each bearing so that when readjustment of the latter becomes necessary, one or the other of the different thicknesses may be removed as the amount of wear upon the bearing may require.

Sometimes when a bearing has been readjusted and undue heating ensues, the trouble may be due to the faulty position of the shim, rather than to the condition of the bearing surfaces or the tightness of the bearing. If the edge of the shim lies against the shaft, there is likelihood of trouble by reason of the shim acting as a knife-edge to scrape the film of oil from the surface of the journal as the shaft revolves.

Factory-made shims usually have the bolt holes punched in such position that the shim cannot readily be replaced in any way other than the right one, but this is not always the case; some of them are so punched that it is difficult to determine which way they should go.

Sometimes a bearing will be found to be loose very soon after a readjustment has been made with "home-made" shims. The probable cause in such cases is the burr or burrs left on the shims at the edges, or surrounding the bolt holes. The burrs form a temporary surface to take the strain of the bolts, but shortly after the bearings have been subjected to the pounding of the connecting rods with the motor in service, the temporary surface breaks down and the cap is then loose.

In the illustration, Fig. 1, the marks shown at *A* on the surface of the journal are caused by the edges of a shim that has been set in such manner that it bears

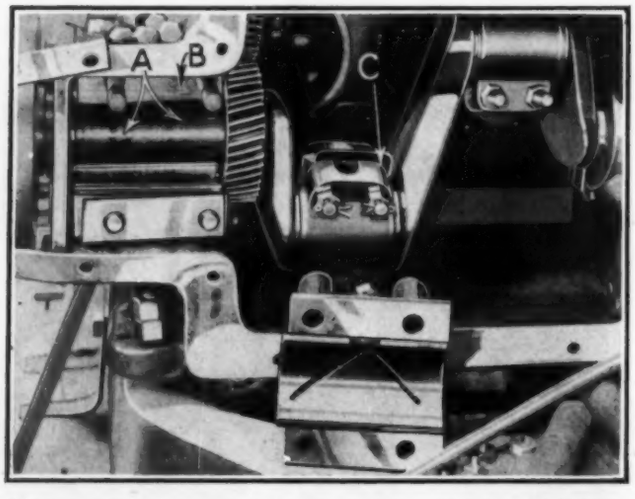


Fig. 1—Damage caused by faulty or misplaced shims

tightly against the revolving shaft. At *B* is the imprint of a piece of gasket material that had been carelessly left between the shim and the body of the bearing, with the result that the cap loosened very soon after the motor had been started.

The shims shown on the opposite side of the same bearing were punched with the bolt holes supposedly at the center, widthwise, of the shim, but as a matter of fact there was a slight variation in this respect, and the shim had been set the wrong way, with the result that the bearing had not received proper lubrication.

In the main crankshaft bearings of a motor, the shims form a part of the dust-proof joint between the upper and lower parts of the case. If the shims are cut too narrow, so that they do not fit snugly to the shaft, there will be left a channel through which oil may leak out, or, in the case of a two-cycle motor, there will be an air leak that may interfere with the

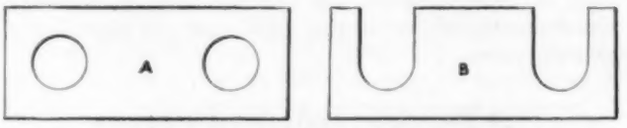


Fig. 2—Two kinds of shims in common use

proper functioning of the machine. Therefore, while it is important that the shims should not be set too close to the shaft, it is almost equally important that they should not be set too far away from it.

Motors that depend upon the splash system for lubrication have some form of spoon, or dipper, to scoop oil from the pan and cause it to flow through suitable channels to the bearings and crankpins. Not infrequently these spoons are also shims for the caps of the rod bearings, as shown at *C* in the illustration. It is possible to place such a shim in any one of four ways, but there is but one correct way, and that depends upon the direction of rotation of the motor. Unless the proper position is noted and marked before the bearing is disassembled, it will be necessary to determine the direction of rotation before replacing the shim.

Punched Holes Better

Most shims are made with punched holes, as shown at *A* in Fig. 2, but the method shown at *B* was formerly much used, and has the advantage that the shims may be taken out and replaced without entirely removing the caps from the bearings. On old motors, on which readjustments must be made frequently, the time saved in making such readjustments may warrant the use of shims of the latter kind, but the shim with the punched holes makes the most trustworthy job, since it presents a better bearing surface, fits more snugly along the journal, and is less likely to become displaced.

Brass is a better material for shims than sheet steel —or "tin cans," as the repair man calls them—for the reason that it will not injure the surface of the journal if left, inadvertently, to bear against it. Brass will also stand more vibration without crystallizing than will steel.

Care used in making and fitting the shims of your motor will forestall a large amount of your bearing trouble.

Experiments have been made of welding metals in an atmosphere of hydrogen and other gases. The object is to prevent oxidation and so secure a better weld. The results have been very gratifying, the weld being much better in every way. Later experiments using ordinary illuminating gas instead of oxygen, has also given interesting results. It seems likely that we shall see further improvements in the quality of welded joints and in the methods of making them.

Types of Manufacturing Gages

Gaging is the process of measuring manufactured materials to assure the specified uniformity of size and contour required by the industries.

Standard—The standard for gaging is a physical representation of a form, dimension, or size established by law or by general usage and consent.

Standard Sizes are recognized or accepted sizes corresponding to various sub-divisions of a recognized unit of length. These are usually expressed in inches or in millimeters, but sometimes by arbitrary numbers or letters.

Basic Size is the exact theoretical size from which all limiting variations are made.

Nominal Size is a designation given to the subdivision of the unit of length having no specified limits of accuracy, but indicating a close approximation to a standard size.

Gages are devices for determining whether or not one or more of the dimensions of a manufactured part are within specified limits. The types of common manufacturing gages employed for measuring the accuracy, or variation from standard, of a manufactured article are: Ring, plug, receiving, snap, caliper, indicating, and fixture.

Ring Gage—One whose inside measuring surfaces are circular in form.

Plug Gage—One whose outside measuring surfaces are arranged to verify the specified uniformity of holes. A plug gage may be straight or tapered, and of any cross-sectional shape.

Receiving Gage—One whose inside measuring surfaces are arranged to verify the specified uniformity of size and contour of material.

Snap Gage—A fixed gage arranged with inside measuring surfaces for calipering.

Caliper Gage—One which, for external use, is similar to a snag gage, and for internal use, is similar to a plug gage.

Indicating Gage—One that exhibits visually the variations in the uniformity of dimensions or contour, the amount of the variations being usually indicated by lever on a graduated scale or dial.

Fixture Gage—The name given to a combination of any or all of the above types, and is employed for the purpose of measuring more than one point on an irregular piece at one setting, or for determining the accuracy of one point in relation to another.

Master Gage—One whose gaging dimensions represent as exactly as possible the physical dimensions of the component. It is the gage to which all other gages, and all dimensions are checked.

Working Gage—One used by the workman to check the work as it is produced. The working gage should not accept any product that the inspection gage will reject.

Inspection Gage—A gage used by the manufacturer or purchaser in accepting the finished product. These gages are checked against the master gage or against the drawing of the part.

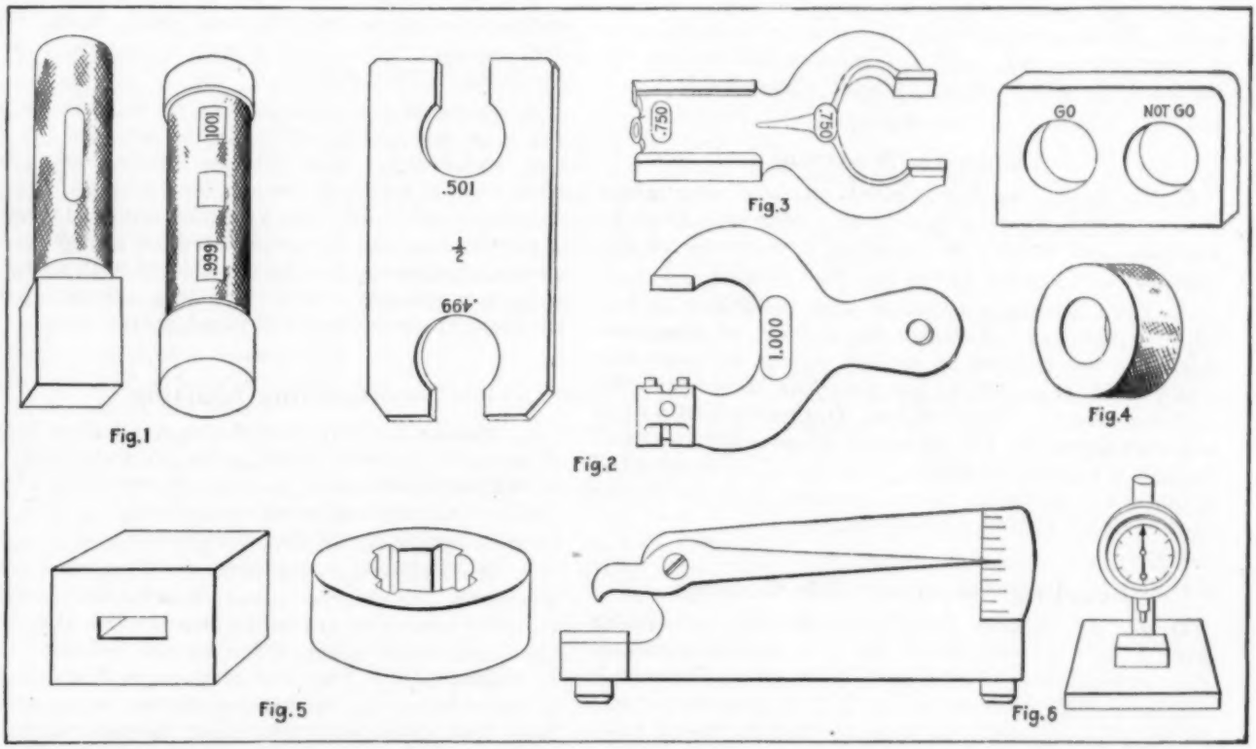


Fig. 1—Types of plug gages. Fig. 2—Solid and adjustable snap gages. Fig. 3—Caliper gage. Fig. 4—Ring gages. Fig. 5—Receiving gages. Fig. 6—Indicating gages

The definitions given are from A.S.M.E. Standards Committee

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Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

Arc Welding in the Shop

Q. We are interested in improving our welding operations. Is arc welding practical for the shop, and has it any advantage for the ordinary run of shop welding?

A. The particular advantage of electric arc welding is in the fact that the intense heat is concentrated in a small area, enabling it to be applied just where it is needed. The metal to be welded is made one terminal of the electric circuit, and the other terminal is the electrode, thus giving the positive control.

Arc welding is entirely practical for shop welding, and has been found to be rapid and economical in railroad repair shops. However, the eyes of the operator and other workmen should be protected by screens from the intense glare of the arc. Much information is put out on the subject by the makers of arc welding equipment, and we advise writing them for literature.

Pneumatic Chucks

Q. Will you please inform us what advantages, if any, are to be derived from the use of pneumatic chucks?

A. The use of pneumatic chucks is especially for production jobs, where the time of the operator is needed on the work, and chucking time must be cut to a minimum. No physical effort of the operator is needed with a pneumatic chuck, and the makers claim that the energy conserved is shown in work efficiency.

Aluminum Soldering

Q. We have a moderate sized specialty shop where it is required to do considerable soldering. Recently we have had trouble in soldering connections to aluminum. Can you tell us the best flux to use?

A. Your trouble is probably with the solder as well as with the flux. Recently the subject of aluminum soldering was covered by articles in Vol. 62, page 437, and Vol. 63, page 236, of the *American Machinist*. We advise consulting these articles. Ordinarily lead solders are unsatisfactory for soldering aluminum. You will require a special aluminum solder, and it is essential to have a thoroughly cleaned surface and use higher heat than for ordinary soldering.

Reaming Aluminum Die Castings

Q. We are having considerable trouble in reaming blind holes ¾ in. in diameter and ⅝ in. deep in aluminum die castings. Our chief trouble is from the reamer not holding to size, and we are not able to ream more than 50 to 75 pieces with one reamer. We are using high-speed steel reamers with inserted blades.

A. Your high-speed reamers are losing their cutting edge more rapidly than a reamer of carbon steel because high-speed steel is not as hard until it becomes heated, and consequently wears out sooner. Another reason is probably a wrong cutting angle on the reamer. For machining aluminum the reamer should have a negative rake angle of about 6 deg. to prevent the blade from digging into the work.

Keeping a Belt on the Pulley

Q. Would you tell me through your Shop Problem Department the best way to keep a belt from slipping off the pulley? Is there a better method than to put a piece of wood against it? The belt is leather, and belt grease does not seem to help any.

A. Make certain that your shafts are in alignment, otherwise your trouble will continue in spite of everything. You should attempt to crown the pulley, that is, to have the diameter at the center somewhat larger than at either side. The natural climb of the belt will then tend to keep it on the pulley. If it is not convenient to take off the pulley and turn the crown, try winding a few turns of a good electric tape about the center of the rim.

Chattering of Milling Cutters

We are experiencing a lot of trouble with milling cutters chattering on wide cuts. The work is plain, and we have been using standard cutters. Can you advise us on this matter?

A. There are several factors of importance which you must have correct in order to get good results on wide slab-milling. The first is rigidity, and it is possible that your machines are too light for the work, or the fixtures are not properly designed and held. Assuming that you have calculated for proper feeds and speeds, another point is to use cutters with spiral teeth to give a shearing effect. Grinding alternate nicks in the teeth of the cutters will break up the chips.

Erecting Shafting

Q. Having recently moved our small shop into part of a rented concrete building, we are puzzled in regard to the best methods of putting up some line shafting. There is no overhead work except heavy concrete beams running across the ceiling at intervals.

A. We advise that you first see the owner, who undoubtedly has original plans showing the location of the steel reinforcement in the beams. It is possible that the latter were designed for certain definite locations of holding bolts. The most common method is to attach a heavy board to the concrete beam, using expansion bolts, and then fasten the shaft hangers to the wood. Although cutting the holes in the concrete for the expansion bolts appears to be simple, we advise calling on one of your local building contractors to do the work, in order to avoid complications.

Technical Abstracts

The American Workman

British views of the American workman say that he likes efficiency because it pays him; measured either in money or in real values, he is the best paid workman in the world. His money is at least twice the highest rates paid in England. Although prices are high, he gets enough to enable him to buy some sort of a motor car, and to secure an interest in, if not complete ownership of his house. Notwithstanding this, American labor is cheap, far cheaper than British labor. An American worker may get twice the money, but he produces four or five times the goods. He does not work as hard but he applies to his job a point of view which is utterly foreign to the Englishman; he accepts readily any suggestions for speeding up, and this is a powerful force in the land constantly hammering for production. A. W. Shaw in *System*, March, 1926, p. 343.

Test for Weldability

It is often desirable to test sheet steel in the welding shop, and the following method can be used. Fit the blowpipe with a small welding head or tip and apply the neutral flame to the smaller piece of the sheet steel to be tested. Move the blowpipe along slowly enough to heat the sheet to the point of fusion almost through its entire thickness but fast enough to prevent it from "burning through." After a section about 3 in. long has been thus heated, hold the blowpipe still and vertical until a hole is burned in the sheet.

In good welding material the path followed by the blowpipe will be free from an excess of oxide and regular and smooth on the upper side. On the under side there will be a slight sag of smooth metal, free from oxide, where it has been heated most. The hole will be round and will have smooth, rounded edges. In poor welding material the path followed by the blowpipe will show an oxide deposit part of which will be porous or flaky, and will be marked by a succession of irregular ripples higher in the center than on the edges. The underneath sag will be covered with oxide and there may even be small holes blown through by the sparking action of the impurities. The hole will be of irregular shape with ragged edges. In welding poor sheet steel it will throw off sparks under the blowpipe, the more sparking the less desirable the sheet, while good sheet steel will scarcely spark at all.—*Oxy-Acetylene Tips*. March, 1926, p. 141.

Centralized Control

A test was recently carried out with the object of comparing a modern centralized-control radial drill with another having the usual gear box at the foot of the pillar, and separate saddle and arm locks. The results of the test show an improvement for the centralized machine tool of approximately 39 per cent in the rate of production without any deterioration in the quality of the product. The machines were timed in detail on drilling and tapping holes in a box form casting using a jig. An important aspect of this matter of centralized control, which is sometimes overlooked is that the operator in his desire to increase output and avoid fatigue will almost invariably take the obvious course of neglecting to lock the sleeve to the pillar or to change the spindle speed when the difference is not very considerable. Such neglect leads to poor work and damaged cutting tools.—*The Automobile Engineer* (England), March, 1926, p. 99.

Heat-Treating Plant

The Reo Motor Co., Lansing, Mich., houses its heat-treating department in a building 300 ft. long and 95 ft. wide. There is a battery of twelve carburizing and annealing furnaces of the under-fired type, using oil as fuel. The furnaces have a heating chamber 78 in. wide, 72 in. deep and with a distance of 33½ in. to the top of the roof arch. Two different shapes of chromium-nickel alloy carburizing boxes are used, several sizes of rectangular pots and two sizes of the cylindrical chimney type. The furnaces are operated twenty-four hours per day and are attended by six men, three men on the day shift and three men on the night shift.

Gear hardening is done in electrically heated furnaces each operated by two men. These furnaces are used in connection with the jig-quenching machines for hardening ring gears. The total net weight of parts carburized during a 9½-hour day run was 138.6 tons, giving a daily average of 14.59 net tons per twenty-four hours, or 1.21 net tons of carburized parts per furnace per 25 hours. The fuel oil consumption per carburizing furnace is 7.1 gallons per hour.—*Transactions of the American Society for Steel Treating*, March, 1926, p. 471.

Drill Factors

When the extreme corners of a drill wear it is a sign that it has been operated at too high a speed, the material drilled may have been too hard or of a non-uniform nature, or the temper of the drill may have been too soft. High rates of speed when drilling cast iron show a marked tendency to wear the drill corners. A peripheral velocity of 35 ft. per minute is accepted as good practice for soft cast iron drilling when carbon drills are used. When high-speed drills are employed the speed may be as high as 100 and 150 ft. per minute.

When a drill chips on the cutting edges the following factors should be investigated: The feed may have been too heavy. The point may have been ground with excessive lip clearance so the cutting edge was not supported properly. Vibration or chatter in the drill spindle may have been present. The material drilled may have been excessively hard. The drill may have been tempered too hard for the particular material being drilled.

When a drill splits longitudinally through the web it is evident that the point lacks clearance or is ground with a hump back on the cutting edge. The necessity for clearance at the center of the drill is often not understood thoroughly. — *Abrasive Industry*, April, 1926, p. 105.

American Machinist

KENNETH H. CONDIT AND FRED H. COLVIN
Editors

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Price and Quality

IN THE News Section of our issue of April 29, our Tokio Correspondent paints a picture of indecisive conditions existing in Japanese rail buying. Foreign purchasers sometimes make a feeble effort to discredit a higher grade article to justify their desire to buy the cheapest, or else try to argue themselves into a belief that their peculiar requirements do not call for the high grade article.

This condition is not confined to steel rails, nor peculiar to Japan alone. American machinery exporters found it in South America immediately after the war, when European manufacturers were flooding that market with hastily built cheap products. The answer is not to be found in a price cutting war with Europe, but rather in continuous educational campaigns by the representatives of American manufacturers to show the ultimate economy of better built articles at the higher prices. Such campaigns have been found to be successful not only in South America, but also even in Europe almost at the doors of the factories that were producing the cheap machinery.

Engineers as Executives

CONTRARY to a rather generally expressed opinion, the engineer is just as likely to succeed as an executive as is a man trained in any other profession or vocation. The evidence in support of this statement is given by engineers now holding such positions. Four of them spoke on the subject at a recent engineering meeting in New York as reported in the April 22 issue.

On one point there seemed to be general agreement—that industrial leaders are born rather than made. In other words, a man who lacks the requisite characteristics of leadership is unlikely to succeed as an executive no matter what his education and training. Conversely, the man who is fortunate enough to possess these characteristics is likely to rise to the top in spite of his handicaps. Just as a college education is not necessarily an assurance of success in life but is an invaluable aid to the man who can put the training thus received to good use, so the experience and knowledge of technical matters gained by the engineer in his college course and industrial work are distinct assets to him if he has the ability to lead others.

A point brought out in the discussion at the meeting was that engineers are apt to be slow in reaching out for higher positions where the duties are unfamiliar. This trait is far too common throughout the industry, and in most other forms of endeavor as well, for that matter. It explains why men are content to spend their lives at the drafting board, drilling holes, feeding presses or adding figures. Perhaps they are not content, but they lack the courage to attack jobs that require thought and initiative and must perforce remain where these characteristics are not demanded.

What is the answer? For some there is none, for others, that they appraise the value of their experience at its true worth and undertake the bigger jobs when the chance offers.

Cheap Power

ONE of the present wonders of the world is the success of American industry in competitive markets although the real wages paid to workers are the highest in history and their living standards are superior to those in any other country. There are several reasons for the existing condition, among them the availability of cheap power.

Here is a way of looking at it that is distinctly impressive. It is possible in the United States to purchase in the form of electric power the energy exerted by a husky laborer during a standard work-day for one-half of one per cent of the wages of that man for one day.

Cheap power is a mighty asset. But it does not give the whole answer because power is obtainable at lower rates in one or two other countries than in the United States. The rest of the answer lies in the application of power through labor-saving machinery that multiplies man-power many times. And that particular phase of industrial activity has been carried much farther in the United States than in any other country.

The Plight of Industrial Designs

UNDER the above title on another page is a short article stating the undesirable features of a bill now before Congress and known as H.R. 6249. The purpose of the bill is to secure more prompt action on design protection and the method proposed is to remove designs from the jurisdiction of the Patent Office and transfer them to the Librarian of Congress who issues copyrights. The principal objection to the bill lies in its potentialities as a breeder of interminable litigation. It is to be hoped that Congress will not pass it but it will be well to communicate with your representative to make sure.

The Functions of the Time Study and Methods Analyst

By Harold B. Maynard
Westinghouse Electric and Manufacturing Co.,
East Pittsburgh, Pa.

His many duties enable him to exercise a unique control over production—The relation of the analyst to various departments—Qualifications

IN EVERY modern plant, there is one man, or group of men, upon whom, more than anyone else, rests the responsibility of producing harmoniously work of the best possible quality at the lowest possible cost. He has been given many titles, some of them rather vague. Efficiency expert, time-study engineer, rate setter, and manufacturing supervisor are some of the sobriquets by which he has been known. In this article, he will be called the time-study and methods analyst, or simply analyst, which, while more comprehensive than some titles, still falls far short of describing exactly his many duties and interests.

Of course, the analyst is not the only one who has the efficient production of a good article at heart. The foreman, the tool supervisor, the planning and schedule clerks, and the cost men all work towards the same end, but the scope of their work is limited to their own particular field. The time-study and methods analyst knows no such limitations. It is his job to see that the work is produced as efficiently as possible, and in so doing, he comes into intimate contact with every phase of plant management and operation. A consideration of just what his duties and interests are, will help to give an idea of the importance of the time-study and methods analyst.

As his name implies, the analyst subjects everything with which he deals to minute analysis. Before he attempts to time-study any operation on any part of an apparatus, he should carefully consider all things which may have a bearing upon it by investigating any previous operations that may have been done and by ascertaining what operations are to follow. From this survey and through a study of the function of the part in the finished product, he can decide whether or not the operation is necessary. He should question the method by which the operation is performed and should consider whether the material, from which the part is made, is best suited to the purpose. The inspection requirements are also investigated. During this whole analysis, quality should be uppermost. The part must be made cheaply enough to sell with a reasonable profit, but it must also be well made so that it will give the buyer service such as he should reasonably expect.

Standardization is vital to efficient production, and methods and parts should be kept as standard as possible. The analyst should suggest to the engineering department changes which will make one part more like another already made, or which will combine two very similar parts into one which may be used for two different applications. He should standardize tools and machine equipment throughout the plant as well as the methods used in operating this equipment. The operators, by repeatedly performing standard operations, soon become experts and thus produce a large quantity of high-quality products. Lastly, the analyst should make suggestions which will bring about the standardization of the materials, thus minimizing stocks of raw materials, short ends, and the danger of running out of material at an important time.

> The material and inspection requirements, the relation to preceding and following operations, and the use of standard machines and methods should all be considered before the actual time study of an operation is made or even attempted.

All this analysis and standardization is a preparation for the actual taking of a time-study. This is often considered the chief function of an analyst. Really, it is only a more or less mechanical adjunct to his main purpose—efficient production at a low cost. Time study to the analyst is like the pencil and T-square to the draftsman. As a tool, it is essential, but without the man back of it, it is useless.

During the time study, the analyst should study the operator as well as the job. He should judge carefully the skill exhibited by the worker and the effort with which he works, and he should use his conclusions in determining a fair time value. The conditions under which the study is taken are noted, and later, if any changes are suggested, it will be possible to tell just how the operation will be affected and how much the time for doing it will be changed. The time study should establish a time value which will be the time in which the average man working with average skill and effort under average conditions can do the job.

When the time value has been established, the

analyst records it so that it will be readily available for use by the planning department, the cost department and the time clerk. He files away his time study so that he can justify the time value at any future time. If for any reason the operator feels that an established value is not correct, the analyst should explain carefully how it was determined and should endeavor to satisfy the man upon its fairness.

The analyst collects much data in the course of his time-study work. From this data he can construct formulas. Usually certain elemental operations are constant for a given class of work and certain others vary with variable characteristics of the work. By combining constants and variables, it is possible to make algebraic expressions which make it possible to establish time values accurately and consistently without actually taking any time studies. Time values can be established on new jobs before they are made, and accurate labor estimates on contemplated work can be given to the cost and sales departments. Since all time values are set from one formula for a given class of work, they will be truly consistent, and the workmen will be well satisfied, once they are confident of the validity of the formula.

Working conditions have an important bearing on the quantity and quality of the work produced, and the analyst should study them with a view towards making the shop as pleasant as possible without going to impractical extremes. A worker likes a clean, well-ventilated workplace with plenty of non-glaring light.

Accidents are costly and the analyst should have safety in mind continually. Since he should be thoroughly familiar with all machine equipment and the methods of operation, he is better able to foresee a possible accident than an observer who is less familiar with the equipment. He should see that safe methods are used in performing the work and should suggest the installation of guards, screens and the like to the safety engineer.

Layout and Equipment

The analyst should reduce material handling to a minimum, and since proper layout will reduce needless backlash and duplicate handling, he should study this thoroughly. The ideal is a straight-line flow of work, but this is not always possible to obtain in all cases where a large variety of work is handled.

Where a new department is to be added to a plant or an old one revamped, the analyst can be a valuable aid to the layout department. He can visualize the sequence of operations which will be done and the method of performing them and can make suggestions with these things in mind.

The analyst should continually study the machines and other equipment in the plant. He will probably be the first to recognize when a line of work is becoming active enough to justify special or automatic equipment and he should keep in touch with the newest developments in machine tools. He will see where the installation of a certain machine will effect a saving and, by a report embracing estimated reduction of labor and the activity of the part under consideration, should show the management just what may be expected from such a change. When someone else is considering the possibilities of new equipment, he goes to the analyst to find out what the difference in labor between the old and the new equipment will be.

The analyst should be constantly on the alert for anything which will save labor and speed up production without detracting from quality. He should consider such things as special tools, jigs and fixtures, special material handling equipment and the like and should balance the cost of such equipment against the saving which might be effected. He is in a particularly advantageous position for devising such things, for he studies minutely each element of an operation, while others study the operation as a whole. Oftentimes, equipment mentally devised is rejected as not saving enough to make any difference, whereas when translated into actual dollars and cents by the analyst it will be found to be well worthwhile.

Personnel Work

The analyst comes in closer contact with the workmen than any of the other members of the supervisory force. Through his analytical time-study work, he has an excellent opportunity to make a detailed comparison of ability, and since he directly influences the earnings of the men, he is in a good position to study their attitude towards management and society in general. Because of this intimate contact, the analyst is able to recommend with certainty good men for promotion. He is able to encourage them to look beyond their immediate job and to fit themselves for advancement by study, both at home and in the shop. In this way, the time study and methods analyst can be an important factor in developing men for responsible positions in the future.

If the analyst finds that a man is unfitted by nature for the particular job he is on, he can call this to the attention of the foreman or the employment supervisor with the suggestion that the man be tried on some other line of work. Moves of this kind generally benefit both the employer and the employee. The analyst is able to do much towards keeping the workers satisfied by interpreting to them the policies of the management in such a manner that they will see the justness of them, and by adopting a neutral attitude, he can help to bring about a mutual understanding. He should convince the workers of the desire of the management to be fair in all things and should show them that by producing a fair day's work they will earn more money for themselves. He should, on the other hand, restrain any worker from doing himself an injury by working too hard in a desire to earn extra high wages. If the analyst is well grounded in the principles of economics, he is also able to dispute popular fallacies in an intelligent and convincing manner.

He can help the workers to plan their work so that it is done in a systematic way. He should encourage suggestions to improve equipment, methods and general conditions and should do what he can to see that all worthy suggestions are given proper consideration.

Relation to Various Departments

Before the sales department can make an intelligent bid for a job, it must know what the manufacturing cost will be. The three main items in the factory cost of a job are labor, material and overhead expense. The material cost is fixed, the labor cost obviously is dependent on the amount of work required to make the job, and the overhead expense is generally tied up with labor cost.

The analyst should study the job from the information furnished him by the sales and engineering departments and should determine how the

work will have to be done. He estimates the amount of time required and specifies the class of labor which will perform the work. The importance of the accuracy of his estimates is evident, for if he should underestimate, the work will probably be done at a loss, and on the other hand, if he should overestimate, the cost will probably appear too high to the prospective customer, and the company will lose the business. The importance of the analyst in this connection should not be overlooked, and the part that he can play in securing business for his company should be fully recognized.

It is the function of the cost department to gather and compile all items of cost on all the products manufactured by the company. The material is billed by the supplier and the labor cost, if labor is on an incentive basis, is determined by the time value which is established by the analyst. The analyst also collects and compiles data and puts it in schedule and chart form on work that is done on the day-work plan, so that the cost department will make a correct and consistent distribution of such items.

The analyst should keep in close touch with the time and payroll clerks and should make sure that they are doing their work properly. When a new time clerk is put on the job, the analyst should make it a point to see that he becomes familiar with operation nomenclature so that he will give out correct time values to the operators. The analyst can help the payroll clerks to work out a method of handling the payroll work whenever a new incentive plan has been established. He is a source of information to them whenever any irregularities occur which necessitate a special procedure. The analyst is often called in to help the cost department design new forms which will facilitate the recording of certain information.

Intelligent dating is absolutely necessary to efficient production control, and systematic routing and scheduling is necessary to intelligent dating. The analyst should interest himself in this phase of the work of the planning department and should give the proper routing and the time allowed for every job that is received. He can, when necessary, work out a system of scheduling and dispatching to be used by the planning department. If the work is properly controlled, there will be a minimum of lost time due to waiting for jobs, tools, material, and the like, and overdue orders will be kept down to a minimum.

Relation to Foreman

Sometimes a foreman loses sight of the cost of doing a job in his desire to get it done. Every foreman wants to keep his expense items as low as possible, especially such items as waiting for work, tools, or material, defective work, and the like. The proper way to do this is by efficient control and not by charging time spent on such items to some other order which would appear to be regular and necessary. The analyst is responsible for correct charges being used on all time turned in, and he serves as a check on any tenddency toward irregularity on the part of the foreman.

The analyst can help to make the job of the foreman easier in many ways. First, by establishing incentive systems, he can eliminate a large part of the supervisory work of the foreman. The foreman no longer has to worry about soldiering on the part of the working force. The foreman is directly responsible for all conditions within his department, and by taking advantage of the desire of the analyst to improve all conditions and to reduce inefficiency as much as possible, he will gain a reputation for running his department well, not enjoyed by less co-operative foremen.

The duties of the analyst are so broad and far reaching that in order to perform his work efficiently he must be familiar with the routine systems of all the branches of the works organization. In viewing the routine work of the plant as a whole, he can notice any duplication of effort more readily than those who are doing only their part of this work and who are looking no further. He is in a position to suggest systems which will give better control, eliminate clerical work and paper routine, and reduce errors to a minimum. He is also able to revise and improve antiquated systems which have outlived the major part of their usefulness.

The analyst supervises the efficiency chart, which indicates at a glance just what an individual or a group of workers is doing. He furnishes the management or superintendent with graphical analyses of cost trends, labor efficiency, idle machine hours and anything else that may be a guide in the control of a factory or a department. This information is obtained from actual figures and is entirely unbiased. It is hence far more valuable than other reports which are based more on judgment and opinion.

Qualifications of an Analyst

The analyst must have a good personality and must be able to get along with people in a positive way. He should have the courage of his convictions and should be able to gain his point when he feels that he is right without losing the co-operation and good will of those opposing him. He deals directly with the workmen through the most sensitive point of contact—the pay envelope. He will meet with obstacles on every hand; yet he must put through that which he believes is right and at the same time must make his work pay dividends. He must have tact, sympathy, and an understanding of human nature and should be guided by its limitations and desires. He must command respect and have good self-control. He must possess very good judgment, be broad-minded, and open to conviction at all times. He must possess a thorough knowledge of the work in his department and all related work in other departments and must be able to judge effort and skill of workmen.

He should have at least a high school training, or its equivalent, and should be well grounded in the fundamentals of algebra and English so that he can express himself clearly in his instructions and reports. The more mathematical training he has the better, for this will be invaluable in formula work. A college training is desirable, if the man has some practical shop experience in addition. He must have an analytical mind and must be able to determine the reason for existing conditions. He should have originality and should always be on the lookout for ideas and improvements.

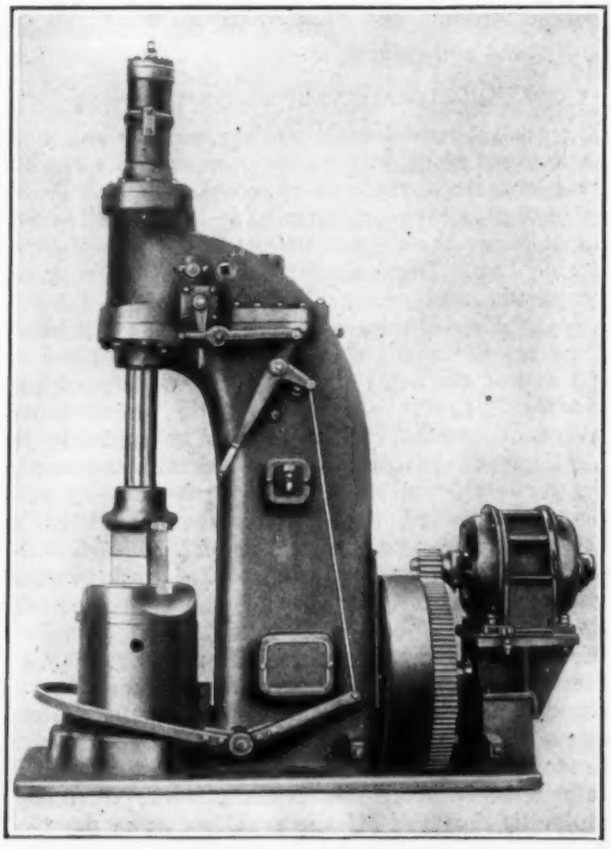
In a great many cases, the importance of the analyst is overlooked, or at least not fully appreciated. This is because it is generally believed that time study is his only function and that ability to read a stop watch and some knowledge of the work he is to study are his only necessary qualifications. Keener competition, however, and the increasing complexity of industry is bringing this man more and more to the front.

Shop Equipment News

"Bates" Pneumatic Forging Hammer

The "Bates" pneumatic forging hammer shown in the accompanying illustration is manufactured by Williams, White & Co., Moline, Ill. The hammer is designed to deliver full power on the first blow as well as full speed on light blows. It is a self-contained unit and can be operated by means of a direct-connected motor or by belt.

The frame and the base of the hammer are cast in one piece. The anvil is a separate casting of gray iron. The bolster or cap for the lower part of the ram so it can be keyed in a diagonal position to permit the working of long bars in either direction in the dies. The upper die is dove-tailed into the lower of the ram so that it can be quickly removed, but is held solidly. A mat is provided beneath the anvil to bear on a cushion sub-foundation and to absorb the shock of the blows.



"Bates" Pneumatic Forging Hammer

The ram consists of a long and heavy solid bar that is of the same size over its entire length. The ram takes the force of the blow directly. It is guided in both the upper and lower cylinder heads which are placed far apart so as to afford as long a length of guide and stroke as possible. No piston rod packing is necessary in the machine. The piston head is forged integral with the body of the ram. The two sides of the ram are flattened at the upper end where they pass through the cylinder head so as to prevent any rotation of the dies. It is claimed the action of the pneumatic hammer is elastic and that light, medium or hard blows can be consistently obtained. The control can be either by means of a hand or foot lever. The treadle extends around the anvil in the form of a semicircle so that control can be had from any position. The operator can stand close to the anvil so that his view of the work is unobstructed. When the treadle is released the ram lifts to the upper end of the stroke and is held suspended so long as the compressor continues running in the idling position. The downward stroke of the ram is produced by means of the compressed air injected into the upper end of the ram cylinder and the force of the blow is augmented by the vacuum created underneath the ram as well as by the compression produced in the top of the compression chamber by the previous upward stroke of the ram. A relief valve is also provided by means of which the compressor may be opened in case the hammer is to remain idle for a short time. This valves is controlled by a hand lever. If the hammer is not to be used for a longer period of time the motor can be shut off.

The hammer is built in a line of six sizes to work stock 2½, 3½, 4½, 6, 7 and 8 in. square, respectively. The size of the die surfaces for these machines is 2¼x5, 3x7, 3½x8, 5¼x9½, 5½x10 and 5¾x11 inches.

The number of blows delivered per minute is 215, 195, 165, 140, 125 and 115, respectively. The hammers are operated through belting 3½, 4, 5, 6½, 7½ and 8½ in. wide. The weight of the ram, upper die and shoe on each machine is 100, 200, 300, 500, 800 and 1,200 lb. The hammers weigh 4,000, 6,000, 9,000, 17,000, 28,000 and 32,000 lb., respectively.

Eisler Electric Welding Machine

The Eisler Engineering Co., Inc., 750 South Thirteenth Street, Newark, N. J., has brought out a welding machine to meet the requirements of manufacturers of fine metal specialties for a rapid production welder. The machine, shown in Fig 1, is designed especially for

Fig. 1—Eisler Electric Welding Machine

Shop Equipment News

sheet metal work, wire welding, jewelry, and metal novelties. It is claimed to weld wire as fine as 0.0005 in. in diameter.

The Eisler welding machine connects directly to a 60-cycle circuit of either 110 or 220 volts, and has a step-down transformer. Adjustments can be made for the various degrees of welding heats required. The breaker points make contact through the action of a foot treadle, the upper electrode moving down to meet the stationary lower one. The current passes through the material to be welded, heating instantly. The speed of production is claimed to depend upon the skill of the operator. Different types of electrodes are

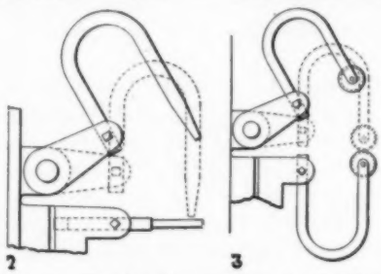


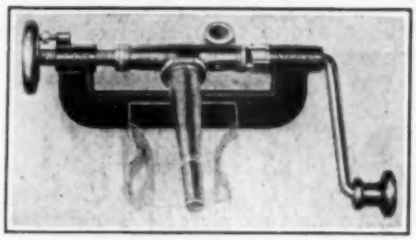
Fig. 2—Electrodes for spot welding. Fig. 3—Electrodes for grid welding

used according to the class of work being done. The welder illustrated in Fig. 1 is equipped with hook electrodes. In Fig. 2 are shown the hook and anvil electrodes used for spot welding, and in Fig. 3 is shown the roller type employed in welding grid. The machine weighs 37 lb., and occupies a bench space of 10x15 inches.

Stevens Refacing Tool for Ford Steering Gear Bushing

A tool for refacing the steering-knuckle bushing of Ford cars has been placed on the market by Stevens & Co., 375 Broadway, New York, N. Y.

The device, illustrated, is a combination fixture and cutting tool. The tool itself is a hollow end mill and is rotated by means of a crank. The crank and tool assembly is supported at the right end of a C-frame. The stub end of the crank shaft protruding through the hollow end mill is a locating piece for centering the



Stevens Refacing Tool for Ford Steering Gear Bushing

steering-knuckle bushing. At the right end of the frame is a dead-center locating piece that is screw-adjusted by means of a handwheel. The work is fed into the tool by means of this screw. The advance of the work is limited by an adjustable stop-screw which is set by means of a gage pin before the bushing is inserted in the fixture.

This tool is said to give an exact fit of the bushing in one operation, the gage being set from the opening in the front axle yoke. The tool weighs 4½ pounds.

Sebastian Motor-Driven Lathes, Type S, Improved

The type S lathes manufactured by the Sebastian Lathe Co., Cincinnati, Ohio, and previously described on page 859, Vol. 55, of the *American Machinist*, are being made with a direct drive from a motor inclosed in a cabinet-type leg.

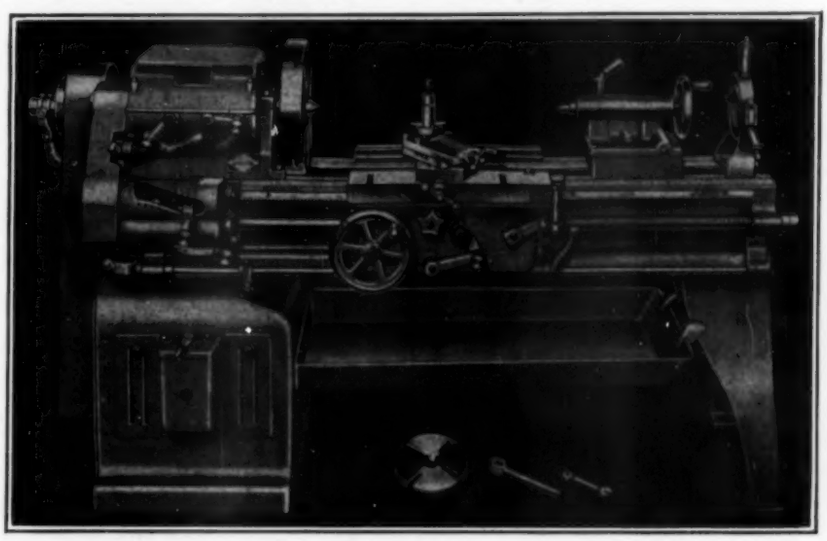
The motor can be removed through the end of the cabinet leg, the construction of which can be seen in the accompanying illustration, by removing four screws. There are two doors in the front and one in the rear of the leg. The motor controller is mounted between the two doors on the front of the machine, as can be seen in the photograph. The entire leg is a solid casting in which ventilation is provided.

The lathe is built in three sizes for swinging work 15, 18 and 20 in. in diam. A 3-in. double belt is used for the 15-in. machine while a 4-in. double belt is used for the 18- and 20-in. lathes. The smaller machine is driven by means of a 3-hp. motor and a 5-hp. motor is used for the larger sizes.

General Electric Control Panel, Two-Speed

A control panel for use with two-speed motors driving baking machinery and machine tools has been designed by the General Electric Co., Schenectady, N. Y. It bears the designation CR-7107-H-1. This device consists of two contactors mounted back-to-back, one contactor having four poles and the other six. One pole of each contactor is used as a holding interlock. A temperature overload relay is connected to each contactor in order to provide protection to the motor at either of the two speeds at which it operates.

A special push-button station for use with the new panel on baking service has "mushroom" heads on each push button of the switch.

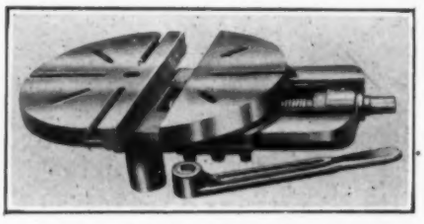


Sebastian Motor-Driven Lathe, Type S, Improved

Shop Equipment News

Modern Machine Tool Co. Combination Drill Table and Vise

A larger size of the combination drill table and vise, illustrated, has been added to its line by the Modern Machine Tool Co., Jackson, Mich. The table is 27½ in. in diam. and is similar in design to the 19-in. table



Modern Machine Co. Combination Drill Table and Vise

previously described on page 203, Vol. 58 of the *American Machinist.*

The jaws of the vise will open 12 in. and they are 27½ in. long. The jaw guides which are 10 in. apart and 4 in. wide, give a jaw support of 18 inches.

The tool has a 1½-in. square-thread screw working in a bronze nut 3½ in. long. The complete table and vise weigh about 580 pounds.

Fairbanks, Morse & Co. Grease Tubes for Ball-Bearing Motors

In order to simplify the lubrication of ball-bearing electric motors, Fairbanks, Morse & Co., Chicago, Ill. are marketing four sizes of "FMCO" collapsible grease tubes. The illustration shows the method of using the tubes.

Fairbanks, Morse & Co. Grease Tubes for Ball-Bearing Motors

The four sizes of tubes correspond to the various sizes of bearings. The amount of grease contained in each is said to be sufficient the bearing sizes specified. The old for a year's supply of lubricant for grease first must be flushed out with kerosene in the usual way, and then the contents of the tube are squeezed into the housing through the hole. The cap of the housing need not be removed.

The advantages claimed for this method of lubrication are many. The grease selected is of a quality that has sufficient adhesiveness to cling to the balls of the bearing and it is of a medium grade to be serviceable when starting the motor cold or for use at full-load operating temperatures. The method of introducing it to the bearing housing by means of the tube prevents outside dirt from being carried in with it. The required amount of lubricant can be readily controlled to reduce waste.

General Electric Drum Controllers

The General Electric Co., Schenectady, N. Y., are marketing a standardized line of drum controllers for general purpose, crane hoist, and machine tool applications. They are designed for either direct or alternating current. In each group several sizes have been provided to cover a wide range of motor ratings. The smaller sizes are suitable for wall mounting and the larger sizes, for floor mountings. Figs. 1 and 2 illustrate the two types, respectively.

The frame of each controller is of the built-up skeleton type and consists of cast-iron cap and bed plates to which are riveted rectangular steel bars. This construction is said to make the switch accessible both from the back and from the front for the purpose of making adjustments and renewals.

The operating handle mechanism is interchangeable. By using another dial plate, a vertical operating lever or a spring-return mechanism may easily be substituted for the horizontal lever with which the switch is equipped.

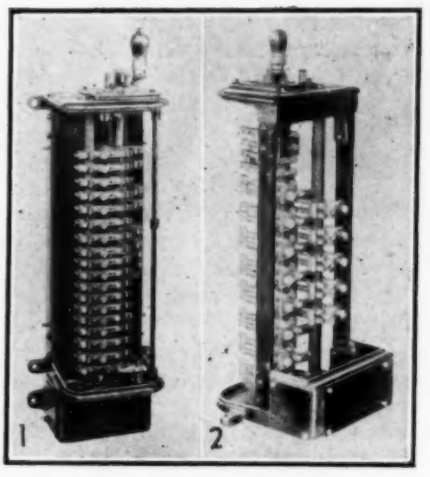


Fig. 1—General Electric Drum Controller, Wall-Type. Fig. 2—Controller suitable for floor mounting

Improved self-aligning contact fingers are used. Renewable copper tips are standardized for all switches of the same capacity. Where cross-arcing is likely to occur, preventive barriers and blowouts are provided. Auxiliary contact fingers for control circuits to the line protective switch are also supplied. The arrangement of these circuits is designed to suit the service requirements of the installation.

Automobile Sales Slow in England

Car and truck sales in England are generally disappointing because of unfavorable weather and the unsettled industrial outlook, according to a cable to the Department of Commerce. Domestic automotive manufacturers are relieved at the settlement of the engineering dispute and a steady output is being maintained, although some light car firms are heavily stocked.

Importers report the lightest March sales in some foreign cars for several years although a few types of popular American cars have done well. Additional price reductions ranging from £10 to £40 have been made on several domestic and foreign makes of passenger cars. Motorcycle sales are below normal but the principal factories are fully engaged. Considerable improvement is expected in England after the Easter season and improved weather conditions, and 12-hp. cars, light trucks and light motorcycles are anticipated as the principal selling lines. Accessory manufacturers and importers foresee increased business as a result of the institution in British postoffices of the cash-on-delivery system.

News of the Week

World Commerce and Economic Progress Analyzed by Foreign Trade Council

Chairman Farrell extols American shipping

The growing importance of foreign trade in the rehabilitation of world commerce, and the economic progress of war-torn nations, was the principal theme of the thirteenth annual convention of the National Foreign Trade Council, held at Charleston, S. C., for three days last week—April 28, 29 and 30. Over twelve hundred delegates attended, representing eighty chambers of commerce and trade associations throughout the country, as well as delegates from Cuba, Porto Rico, Mexico, China, Japan, India, Great Britain, Germany, Russia, Brazil, Panama, Colombia, Hawaii, the Philippines, Greece, Egypt, South Africa and Ireland. Fifty delegates represented the executive departments of eighteen of the largest American railways.

The United States Government was represented in a large way. There were forty delegates from the Department of State and the Department of Commerce, besides others from various departments. Rear Admiral William A. Moffett, head of the Navy Department, Bureau of Aeronautics, came by airplane. Twenty-eight naval seaplanes accompanied him and remained in the city during the convention.

Praises Marine Service

The principal speaker at the opening session of the convention was James A. Farrell, of New York, president of the United States Steel Corporation, and chairman of the council. Mr. Farrell said that in spite of handicaps more ships were now operating under the American flag, and a larger proportion of American cargo was being carried in American ships, than before the war.

Mr. Farrell spoke in part as follows:

"The world as a whole continued last year the economic recovery and improvement which has marked its course steadily since the close of the war. It is evident in several ways that the process of accumulation which was interrupted for four years is gaining momentum each year by the added force of its own annual savings. Production is on the upgrade in all the industrial nations, and most of them have brought their international commerce nearly up to its pre-war level.

"The figures of thirty-three exporting nations, not including the United States, for the last fiscal year, showed them to be within 7 per cent of their pre-war volume of trade. The United States and Canada alone of all the trading nations have made a substantial increase over their pre-war status. If our figures are included in this calculation, the world as a whole is shown to be only 2 per cent under its pre-war volume at the close of the last fiscal year. There are some indications that this deficiency will be more than recovered in the current year. One indication is the increased volume of raw material imports, both by the United States and by several of the industrial nations of Europe. That, of course, evidences an impending increase of production, and of consuming power.

"Contrasting with our export showing is our import of materials for industry, crude and semi-finished. They are 58½ per cent of our total imports. To such an extent has our industrial establishment as a whole developed, that it is dependent, for the fulfillment of the fundamental condition of prosperity—occupation—upon a steady inflow of raw materials from foreign sources, aggregating at least two billion dollars a year in value, and constituting three fifths of our total imports. Curtailment of such supplies, or abnormal prices for them, inevitably affect industrial activity in all countries and, in this connection, it is realized that national trade is the basis of national livelihood.

"The first nineteen items on our export list last year account for 60 per cent of our total exports. They included all the factors which contributed 1 per cent or more to our total. Of these nineteen items, only five were crude materials, including raw cotton, tobacco, wheat, coal and crude oil. The remaining fourteen were either finished manufactures, such as automobiles, cotton cloth, wheat flour and agricultural machinery, or articles partly processed, such as refined oils, sawed lumber leather and steel products.

"In these figures we have a glimpse of what has been going on in the way of development of our foreign trade in the last ten or fifteen years, and of what is before us for the next decade. Before the war our foreign trade was incidental and occasional with all but few of our manufacturing concerns. Then it was only here and there that a manufacturer gave steady thought to the advantages of sharing in foreign markets, and our overseas commerce was spoken of slightingly as representing 'only 4 per cent of the total.'

"We are reaching the stage of expanded interest and participation which tends to diminish the risk of the whole because of its widened distribution. No doubt there will be setbacks, local depressions, and situations unfavorable to a single line over an extended period, or unfavorable to several lines over a shorter time. We have developed a mass interest and participation in international commerce which spreads and reduces the shock of individual misfortune or lack of success.

"There is still plenty to do. We must not fall into the error of thinking that because we have reached a creditable position by hard work and intensive application we can remain there without further effort. The policy of inertia is the practice of disaster. Work solved the problem of success. It must be kept up to maintain the results. Of the four great factors which contribute essentially to the maintenance of our foreign trade; production, communication, finance and transportation, we are equipped best in the first. Improvement has been made in the other three. Ever since the beginning of the war the world has been living on a lower plane than had been its custom. It is gradually getting back to a pre-war status of production and consumption and in that lies the hope of betterment. The foreign trade outlook cannot be accurately forecast, but there are signs of recuperation and strengthening in the whole industrial fabric."

Canadian Session

A feature of the days meeting was a session devoted to Canada. The cordial and beneficial trade relations and warm friendship of the two nations were extolled by C. P. W. Schwengers, president of the Chamber of Commerce of Victoria, B. C. Mr. Schwengers cited the immense volume of business Canada carried on with the United States, saying that each Canadian spends $70 a year for American goods.

Other Canadian speakers were G. F. Towers, inspector of foreign branches, Royal Bank of Canada, Montreal; Lynn W. Meekins, United States Trade Commissioner, Ottawa; Traver Sweatman, K. C.; George Wilson, president of the Board of Trade, Toronto; Colonel Robert Sparke, president of the Board of Trade, Montreal.

The following message of greeting was received by Mr. Farrell from President Coolidge:

"Please present my greetings to the delegates assembled for the thirteenth annual convention of the National Foreign Trade Council. We realize that a country enjoys good times to the extent that business is prosperous. Business prosperity depends in no small degree on the amount of our foreign trade. An important requisite for such trade is the existence of amicable international relations. Your organization has done much along these lines while increasing good will for our products. May your efforts in this direction continue to be increasingly successful."

The second day of the convention heard addresses of Dr. Jeremiah W. Jenks, of Alexander Hamilton Institute; Henry M. Robinson, president of the First National Bank of Los Angeles; and Fred I. Kent, vice-president of the Bankers' Trust Co., of New York.

Mr. Robinson spoke on "The European Situation of 1926," and made some very pointed observations on business conditions abroad. Speaking specifically of Germany he said:

"Let us turn to the question of how much of a burden the reparations charge actually is on the German producers. The annual income of Germany for the year 1925 is set up by statisticians at about fifty-five billion marks. The standard payment, beginning in 1928-29 calls for the collection and deposit in the Reichsbank of twenty-five hundred million Reichs Marks. This is less than 5 per cent of the value of annual income; in other words, 95 per cent of income must support the full 100 per cent of producers, while the remaining 5 per cent is applied to reparations. Reduced to the worker's hours, if, as is now contemplated, the worker's week in industry is to be forty-eight hours, a little over two hours per week out of the forty-eight will produce the worker's contribution to the credit in the Reichsbank. Does this sound like an undue burden?

A Good Comparison

"Comparing the burden of the reparations collection with the burden of taxes collected before the war for the maintenance of the Military Department of the German Government, we find that the actual accounted for outlay for the year ending March 31, 1914, was over sixteen hundred million Reich marks, ($407,000,000), that is over two thirds of the annual standard reparation payment. To this should be added the free services rendered by the other governmental agencies, such as free transportation of men and materials on all railroads and a certain proportion of the ship subventions and the loss of the productive power of the men so withdrawn from industry and we find a considerably greater burden for the support of the military than is required for reparations.

"As to the immediate situation in Germany the testimony varies. While at the present moment there are difficulties in industry yet some of the leading German authorities, as well as our own, conclude that it will prove temporary, and that it is nothing other than the crisis that might be expected from the re-adjustments following stabilization, and especially from the raising of tariff barriers in Europe, and from the competition Germany has with countries where currencies are steadily depreciating. The evidence is strong that the condition will result in the marked improvement of the economic health of Germany. Her currency has been stabilized, her budget brought into equilibrium, the Reichsbank has increased its gold reserve, bank deposits have increased, savings deposits having more than doubled during 1925, average wages in industry to labor have been increased, and taxes have been reduced."

Speaking more generally of Europe he said:

"The most disturbing situation in Europe is the depreciation of the French currency. The first step in recovery has been taken; legislatively the budget has been brought into balance. It remains to be seen whether the taxes called for under the law can be collected. Would it not be easier to collect the taxes if the value of the currency was made definite and was either legislatively stabilized or practically stabilized at some given value? Would it not be quite possible for France to stabilize its currency if it could arrange credits, not extremely large ones, to protect the currency from speculative onslaughts? Would there be any question about the ability to obtain such credits if a basis for adjustment of her external debts had been fixed? It is true that the flight of capital continues and that capital will only return with stabilization. However, it appears the difficulties in the countries having unstable currency are not insurmountable.

On Friday, the last day of the convention, there were three group sessions at which addresses were delivered by W. R. Cummings, president of the Export Managers' Club; G. R. Parker, president of the American Exporters and Importers Association; James S. Martin, foreign publicity director of the Remington Typewriter Co.; David L. Brown, sales manager of the Goodyear Tire and Rubber Co.; G. G. Crawford, president of the Tennessee Coal, Iron and Railroad Co.; and C. C. Martin, of the National Paper and Type Co.

Pratt & Whitney Managers Hold Convention

On April 26, 27 and 28 a sales convention was held at the plant of the Pratt & Whitney Co., of Hartford, Conn., for the managers of its branch offices. The meetings were held in the new demonstration room at the plant and were attended by twenty men from the branch offices, and by the executives and heads of departments at the plant.

On Tuesday evening a dinner was served at the Farmington Club which was attended by the visitors, executives, heads of departments and foremen to the number of 150. The gathering was addressed by Col. E. A. Deeds, chairman of the board, the Niles-Bement-Pond Co., who spoke upon the need of mutual acquaintance throughout the organization.

An interesting feature of the dinner was the presence at the table of two men whose combined term of service with the company covers a period of 118 years, each having been with the Pratt & Whitney Co. for 59 years. One of these men is now retired on pension, while the other is still actively engaged.

It is the intention of the company to repeat these conventions at intervals of two weeks until the entire field force of over 100 men have had opportunity to inspect the plant and observe the machines which they sell engaged in actual production work. The object of holding separate sessions in this manner is to accommodate all of the men without interfering seriously with the activities of the branches, as would be the case if all of the men were to be withdrawn at the same time.

Foundry Equipment Manufacturers in Convention

At the spring meeting of the Foundry Equipment Manufacturers' Association, which was held at French Lick, Ind., April 22 to 23, arrangements were completed for the association to be represented at the annual foundry exhibition in Detroit in September. Data regarding the activities of the association will be available at the exhibition, and the booth will be in charge of a special representative of the organization.

The attendance at the French Lick meeting was the largest in the history of the association. Nearly every member was represented, and a large group of invited guests also were present. A number of new members were obtained, with definite assurances that the growth of the organization will continue throughout the year.

S. T. Johnson, of the S. Obermayer Co., Chicago, president of the association, presided assisted by vice-president T. W. Pangborn, of the Pangborn Corporation, Hagerstown, Md.

The reports of business conditions indicated that there was a high degree of activity in all departments during the first quarter of the year, averaging about 25 per cent in excess of 1925. Shipments are still heavy. New business continues normal.

G. B. Pickop, of the Malleable Iron Fittings Co., Branford, Conn., submitted a report covering recent progress in the development of permanent molds. P. B. Crouse, of the Whiting Corporation, Harvey, Ill., described the application of the group bonus plan of wage payment. This method of payment by results, according to Mr. Crouse, avoids the difficulties which frequently are encountered in setting piece rates, resulting in definite increases in production, a more satisfied body of workmen, better direction on the part of the foremen (who also receive bonuses), and a much reduced labor turnover.

"Long Terms on Machinery Sales" were discussed by A. F. Jensen, of the Hanna Engineering Works, Chicago. S. C. Vessy, of the W. W. Sly Manufacturing Co., Cleveland, presented a report on conditional sales. C. E. Hoyt, executive secretary of the association, described the arrangements for the Detroit exhibition of foundry and shop equipment, which is expected to be the largest ever held. The association pledged its co-operation in the entertainment of the overseas delegates who will attend the Second International Foundrymen's Congress,

A.B.M.T.M. Does Not Control Prices

The Association of British Machine Tool Makers recently announced that its membership consists of nine firms, each making different types or sizes of machine tools. The total of machine tool manufacturers in Great Britain is more than 100. The A. B. M. T. M., as the association is called, does not attempt to control prices of the machines made by its members, but is simply a co-operative selling effort of the member companies.

Dual Convention of Dealers' and Manufacturers' Associations to Be Held

Manufacturers and dealers in mill supplies will co-operate in airing the problems of marketing and distribution when the American Supply and Machinery Manufacturers' Association and the Southern Supply and Machinery Dealers' Association meet at the Hotel Statler, St. Louis, Mo., May 18, 19, and 20. The morning sessions will be devoted to separate meetings of the two associations while in the afternoon both bodies will hold joint discussions.

The program of the dual convention is a well-balanced one and includes talks on both buying and selling as well as two speeches one by L. M. Harris, financial editor of the St. Louis *Globe-Democrat*, and the other by Merritt Lum, publisher of *Factory and Industrial Merchandising*.

An executive session of the Southern Supply and Machinery Dealers' Association will be held on Tuesday, May 18, at 10 a.m. and on the same morning at 10.30 the executive committee of the American Supply and Machinery Manufacturers' Association will meet separately. N. A. Gladding, of E. C. Atkins & Co., will be the chairman of the first afternoon session of the two associations, which will be held at 2:30. The subject for discussion will be, "Is it Economical Purchasing for a Large Corporation to Be Shopping Around?" The discussion will be followed by Mr. Harris' speech on "Commercial Sportsmanship." The chairman for the second session of the afternoon, to be held at 3:30, will be D. R. Burr. The subjects for discussion are to be "The Practice of Some Manufacturers of Alloting More Tonnage to a Dealer than his Necessary Stock Requirements, Resulting in Demoralization of the Market when Unloading Surplus," and "Odd-Sized Material."

Marketing Problems

The executive session of the Southern Supply and Machinery Dealers' Association to be held on Wednesday, May 19, at 10 a.m. will be devoted to marketing problems. Topics for discussion will be: "The Use of Slogans as a Means for Attracting Business," "Are Bonuses to Salesmen Satisfactory?" "Are Results of Discussions of Trade Practice at Annual Conventions Productive of Reform?" and the report of the special committee on sound business practice. The Manufacturers' Association at the same hour will hold an executive session to receive the reports of committees on auditing, membership, industrial legislation and of the executive committee. Resolutions and nominating committees will also be appointed.

The chairman of the first session for Wednesday afternoon will be A. C. Kingston and the discussion will center on "Compensation to Dealers on Manufacturers' Direct Sales" and "Hand-to-Mouth Buying." The topics for the second session under the chairmanship of Dixon C. Williams, will be "Specialty Salesmanship" and "Maintaining Suggested Resale Prices."

The annual report on cost distribution and the profit loss on returned goods will be discussed at the executive session of the Dealers' Association, to be held on Thursday morning, May 20. Reports of committees, including the nominating committee, will also be received. At the same hour the Manufacturers' Association will hold its election and receive the report of the resolutions committee.

Metric Legislation Again Fails in House

Efforts to increase the use of the metric system of weights and measures by law again have failed to meet the approval of a congressional committee. The preceding effort was before a Senate committee. After extensive testimony had been taken in favor of the legislation and voluminous briefs submitted, the sub-committee dropped the proposal without even a report to the whole committee.

A more pretentious effort to forward metric legislation was made at this session of Congress, but it has met the same fate. The proponents of the legislation had the advantage that the author of the bill and chief champion of the metric system in Congress, Representative Britten, of Illinois, is a member of the committee having jurisdiction.

The Metric Association then presented the draft of a resolution proposing a survey of the weights and measures situation by the Department of Commerce, but so worded the resolution as to make it an endorsement for the system and practically to instruct the Department to bring in a report favorable to the system. This resolution was referred to a sub-committee which modified the original somewhat and in that form it was introduced by Representative Lowrey, chairman of the subcommittee. On April 29 the resolution came before the full committee. The "whereases" were stricken out and the resolution amended so as to provide simply for a report on the advisability of adopting the metric system for general use in the United States. The resolution in that form, however, was opposed by Mr. Lowrey. The committee then dropped the entire matter.

The resolution introduced by Representative Lowrey read as follows:

"*Whereas* the metric system of weights and measures is accepted generally for international use; and

"*Whereas* the use of such system is by law required by a majority of the nations of the world; and

"*Whereas* the states of California, Illinois, Tennessee, North Dakota and Utah have memorialized the Congress to enact legislation adopting such systems; and

"*Whereas* such system is decimal, practically, easy to learn and convenient to use; and

"*Whereas* there exists a strong sentiment in favor of universal use of a standard system of weights and measures: Therefore be it

"Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, that the Director of the Bureau of Standards is authorized and directed to conduct a thorough investigation and study to determine the advisability of adopting, for general use in the United States, the metric system of weights and measures. Such director after making such investigation and study shall initiate and carry out, to such extent as he may deem advisable, plans to encourage the general and common use in the United States of such system of weights and measures."

The resolution was drafted by a subcommittee of the Committee on Coinage, Weights and Measures consisting of Mr. Lowrey, Mr. Fitzgerald, of Ohio, and Mr. Wolverton, of West Virginia. Mr. Wolverton opposed the entire resolution.

Undaunted by the complete failure of their efforts to launch legislation on the House side of the Capitol, the advocates of the metric system have prevailed upon Senator McKinley, of Illinois to introduce the bill in the Senate. Senator McKinley states, however, that he has no plan for pressing the legislation at this session of Congress.

Machinery Exports Fell Off in March

Exports of metal-working machinery for March, with revised comparative figures for March, 1925, as compiled by the Department of Commerce, are as follows:

	March, 1925 Value	March, 1926 Value
Lathes	$261,593	.....
Boring and drilling machine tools	60,582	.....
Planers, shapers and slotters	76,773	.....
Bending and power presses	74,412	.....
Gear cutting machines	84,196	.....
Milling machines	227,121	.....
Punching and shearing machines	20,420	.....
Power hammers	23,963	.....
Other metal working machinery and parts of	520,628	.....
Engine lathes	.....	11,276
Turret lathes	.....	27,358
Other lathes	.....	70,801
Vertical boring mills and chucking machines	.....	26,248
Thread cutting and automatic screw machines	89,007	75,007
Knee and column type milling machines	.....	20,975
Other milling machines	.....	58,936
Disk type gear cutting machines	.....	61
Other gear-cutting machines	.....	77,898
Vertical drilling machines	.....	10,627
Radial drilling machines	.....	8,061
Sensitive drilling machines	.....	17,078
Other drilling machines	.....	13,341
Metal sawing and cutting-off machines	.....	6,324
Shapers and slotters	.....	34,917
Planers	.....	558
External cylindrical grinding machines	202,243	99,026
Internal grinding machines	46,913	46,328
Metal-working tool sharpening machines	.....	16,454
Other metal grinding machines	63,341	29,941
Sheet metal working machines	.....	50,624
Plate metal-working machines	.....	736
Rod or wire-working machines	.....	22,423
Forging machinery	.....	104,150
Rolling mill machinery	.....	58,351
Foundry and molding equipment	49,951	51,735
Other power-driven, metal-working machinery and parts	.....	358,382
Other metal-working machinery (total)	412,730	339,369
Hand or foot operated metal-working machinery and parts	.....	6,379
Pneumatic tools	97,859	93,456
Other portable metal-working machines	.....	22,523
Chucks for machine tools	36,509	32,416
Reamers, cutters, drills, taps, dies and other metal working tools	278,362	184,595
Total	$2,626,603	$1,976,354

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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THE business world seems to have recovered the poise that was somewhat disturbed last March when the stock market collapsed. But there appears to be but little likelihood of the rejuvenated boom that some are predicting. The political outlook in the United States does not favor it. The country is just a little afraid of the Congressional elections that are to be held next autumn and the aggressiveness with which some economic novelties in the way of legislation will be exploited by prospective candidates.

Then there is the tariff issue. Lower import duties are strenously demanded by many who pose as the protagonists of the farmers. Economists admit that Mr. F. I. Kent puts the case trenchantly when he says that we have reached a point at which our imports measure our control of exports. But the threat of a tariff reduction has never been accounted a favorable influence in the United States.

But the foregoing comprises about all the unfavorable portents that are discernible and although some pessimism is expressed in certain quarters, it must be admitted that business is about as usual throughout the country.

In the cotton textile industry there is some complaint and even among the rayon manufacturers there is talk of a reduced demand for their product although prices are not quotably lower. The market for woolen goods is also slack and raw wool is lower in the United States although prices were well maintained at the auction sales recently held in London. As a result it is possible that some of the foreign wool now in this country may be shipped to Europe.

In the cotton markets where futures are dealt in there has not been much change. But new crops are very sensitive to any unfavorable news from the South and it is quite possible that a revival of speculative activity will be seen when the May deal is out of the way.

The grain markets are statistically strong but commercially quiet and no increase of activity in the near future is indicated. Coffee has advanced somewhat upon the theory that a Brazilian loan for 30 million dollars that is now being negotiated may help indirectly in sustaining values. But hand to mouth buying in the United States is still the rule.

The Cuban Congress has passed the bill that limits the Cuban production of sugar to about 4,720,000 tons, but most sugar dealers appear to be from Missouri and they are waiting to see what the effect will be. It is generally assumed that the large stocks held in Cuba must be disposed of before the market can advance, but this theory presupposes a compulsory liquidation that is unlikely and taking all the facts into consideration there is no present indication that the supplies of sugar for the current year will be in excess of the demand.

On the Stock Exchange business has been alternately active and quiet. The rails have been strong because the net earnings for March were the largest on record, but the market is no longer responsive to the talk of consolidation and the financial community is not quite as confident as it was that the Van Sweringen merger will be reattempted.

The consumption of gasoline has made a new high record and the fact has been duly exploited by the automobile dealers. They continue nevertheless to complain that the market for new cars is obstructed by the difficulty encountered in disposing of second-hand machines.

The money market is unchanged and bank credit is in abundant supply. The Federal Reserve statement requires no comment. Foreign news is interesting but is not important in its immediate bearing to American business.

The debts due our Government by Belgium, Latvia, Esthonia and Roumania have been refunded with the approval of the United States Senate and an agreement with France that will dispose of her indebtedness to this country has also been reached, although it awaits the ratification of the Senate. French francs have sold as low as 0.0327½ but they have recovered somewhat upon the theory that the French government will adopt a constructive financial policy as soon as its debt to the United States is refunded.

As this is written the threatened coal strike in Great Britain still awaits adjustment but precedent encourages the belief that a compromise will be arrived at and it is at least significant that unemployment in England is decreasing. According to the latest figures those who were without work in England numbered 997,000 as against 1,201,000 at the end of January.

German exports for March exceeded imports by 278 million marks and other reports from Germany indicate a great improvement in economic conditions there.

In Canada there has been a marked improvement in business. The Canadian dollar is at a premium in New York and much of the gold sent us recently is being returned to Montreal.

But the reduction thus effected in our surplus supply of the yellow metal is negligible and with the abundance of bank credit thus assured any important recession in American business seems unlikely.

What's Doing in Industry

Business in machinery and machine tools continues active although the present volume of orders is somewhat below what had been expected for this time of the year. It would appear from authentic reports that retrenchment on the part of the automotive industry has caused the slackness. Large industrialists are buying, but not in sufficient quantity to justify a statement that business is on the upward trend.

New England presents an optimistic picture this week, sales being active and production running 15 per cent ahead of last year. The South is also busy and new construction enterprises have created a good market for machinery. In Canada business is forging steadily ahead, but the automotive industry is handicapped by the recent tariff changes.

In the Mid-West business is unusually quiet. Detroit reports little activity; Chicago admits a slight falling off in sales but an increase in inquiries. Business in Indianapolis is active but not up to the average attained last quarter, although it is ahead of last year. Cincinnati reports an increase in inquiries. The New York market is rather colorless, new inquiries from railroads being the best market indicator.

Latest figures of the Department of Commerce show that exports of machinery and metal-working equipment in March were considerably less in value than they were in the same month last year. Boring mills, planers, gear cutters and milling machines fell off, while an increase is shown for turret lathes, vertical and radial drills and sawing machines.

The business world seems to have recovered its poise, but there is little likelihood of the rejuvenated boom that some have predicted.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

New England

Forecasts made previously of a busy year for the machine builders are becoming more pronounced each week. The machinery industry in the New England territory, especially in Connecticut, is running ahead of a year ago. Surveys of the industry here show that in operations the improvement is between 10 and 15 per cent over the corresponding time in 1925; and in employment the improvement averages 7 per cent increase. On a basis of man hours the improvement is placed at 17 per cent.

Some heavy buying by the automotive industry gives an added impetous to conditions in New England. Part of this buying is for expansion plans of auto manufacturers and the amount of replacement business holds steady. Grinders, milling machines and lathes are being bought. Automatic production machinery is also selling well. Hand tools are selling, especially in foreign markets. Special machinery builders have more business than they can handle.

There is a good demand for second-hand machinery in this territory and good prices are being obtained.

Southern District

Machine tool business in the Southern territory showed a steady tendency toward improvement during the latter part of April, with inquiries especially good. The month as a whole, however, was not up to expectations. The present tone of inquiries would indicate that business should continue to hold up well during May and the rest of the spring.

The large amount of new construction in progress in the Southeast, or planned for the spring and summer, is creating a demand for contractors' equipment, and the inquiry for this type of machinery is good. Road-building machinery is in good demand and present indications are for equally as good a year as in 1926. There is much disappointment among dealers doing business in Georgia, however, over the failure of the extra session of the Georgia legislative body to pass an adequate road bond issue.

Smaller machine shops and service stations are not buying very actively, and what little buying they are doing is almost entirely for rebuilt or used equipment.

Textile machinery is still comparatively inactive but has been improving at a fairly good rate the past few weeks. Railroads are improving their orders a little, and most dealers are anticipating a good volume of business in this field during the remainder of the year.

Canada

With the exception of the automobile industry which appears to be temporarily paralyzed as a consequence of the recently announced tariff reductions on cars and trucks, business in the metal-working industry of Canada continues to expand. There has been a notable improvement in foundry conditions. Some plants are booked for months ahead with orders from the railways and agricultural implement shops. The Sydney Steel Works is now operating at 75 per cent of capacity and on the basis of business already booked, this rate will continue.

The Ottawa Car Manufacturing Co. reports orders from the Ontario Hydro Electric Power Commission for several cars; from the Nova Scotia Tramways and Power Co. for four cars, and from the Reo Motor Co. for sixteen 21-passenger bus bodies. Three equipment companies, the Eastern Car Co. the Canadian Car and Foundry Co. and the National Steel Car Co. benefit from orders for 150 pieces of rolling stock just placed by the Canadian National Railways. For what is said to be the first time in the history of railroading, an American railway has placed an order for cars with a Canadian company, the National Steel Car Corporation having received a contract to build 350 automobile cars for the Pere Marquette Railway.

Cincinnati

Although the past week has had no outstanding feature, machine tool manufacturers of Cincinnati state that it has not been without at least some encouragement. While the increase in orders booked was not large, taking the industry as a whole, the number of inquiries coming in are an indication of potential sales and a livelier market.

Selling agencies state that the market showed a slight upward trend in the past week, and they, too, report an increase in inquiries that they regard as encouraging. General business has been retarded by the late spring, it is explained, but now the weather is seasonable, and while this is only an indirect influence, it will help to improve the machine tool market.

The greater part of the week's sales by both the manufacturers and the selling agencies has been to general machinists and industrial users of machine tools. The orders came from all sections of the country and the purchases were well diversified as to sizes and types of tools. Sales to manufacturers of automobiles were almost entirely confined to concerns that are changing their models, and need new tools for that purpose.

Plants of the local machine tool concerns are maintaining their output and are employing the usual working forces, and it is stated that orders on hand and coming in will keep production up to its present level. While sales are still confined almost entirely to single tools and replacements, the aggregate is regarded as being satisfactory.

Detroit

A seasonal slump prevails in sales of machinery and machine tools in the Detroit district. Representative dealers are divided in their opinion as to when the slump will end, some maintaining that the backward spring has had everything to do with machinery sales, while others feel that over-production will mean a quiet market for some time.

There is no question but that automobile plants have been turning out motor cars faster than the sales departments have been able to dispose of them, statements to the contrary notwithstanding. Production has been high during the first four months of the year, but sales have not.

Most of the Detroit plants, as well as those in Lansing, Pontiac and Flint, were tooled up for big production on the first of the year, and as a consequence buying has fallen off perceptibly. There is some business to be had, but competition is keener. No big business is being placed, most of it being pick-up orders here and there.

The tool shops and jobbing shops are rather quiet, most of the activity, such as it is, being confined to the larger automobile manufacturers.

Indianapolis

Little change is to be seen in the machinery and tool demand in this territory. Business is not as active as the trade desires, but it is somewhat better than it was at the same time last year. A backward spring, with temperatures far subnormal, has done much to delay business.

A fair volume of business is developing from railroad shops. Most of these shops now are working full time and a good volume of repair work is to be done before next fall. This has meant an increase in the tool demand. The same situation is true here of the interurban utilities, where repairs have to be made.

Demand from automotive sources is good, much better than a year ago. A report from one of the largest factories in the state shows a much healthier business condition the first quarter of this year.

New York

Business continues at an even pace in this market. No large orders have been recorded, but sufficient new inquiries have appeared to warrant the conviction that the month just opening will see a generous revival of sales. April as a business month was below expectations, but the reasons for the disappointment are satisfactory.

Industrial users of machinery and machine tools are the best buyers now. A few orders have been received from railroads, but these have been for single tools of special design. Small tools and miscellaneous shop supplies are in good demand.

There has been an unusual demand for welding equipment in the past few weeks, mostly from construction interests.

The General Electric Co., the New York Central Railroad, the International Motor, the Columbia Steel Co. and the American Steel Wire Co. are mentioned as recent buyers. The Columbia bought six cold rolling mills, and the American company bought five cluster-type cold rolling mills.

Chicago

Little improvement in the machine tool market is reported in any quarter. The industry may be said to be marking time in every department. Wood working tools are active, manufacturers of and dealers in this line report a steady and satisfactory business. As compared with a week ago, there is a slight falling off in sales, although inquiries covering requirements for both new and used machinery of various types are being received from all sections.

Despite present inactivity, however, an underlying optimism pervades the trade, and the belief is general that May will witness a decided upward trend. Such demand as there is consists mainly for punch presses, millers, shapers and planers. With the exception of the Chicago & Northwestern, which has been buying some equipment for one of its branches, railroads have not come into the market for tools.

New Auto Body Factory Starts in Germany

A German-American factory for the manufacture of steel automobile bodies has recently been formed in Germany as a limited liability company with a capital of 7,500,000 reichsmarks, according to an article appearing in the German press. It is reported in Germany that the new company will produce cold-pressed all steel bodies and other pressed steel parts for the automobile industry.

The founders of the company are stated to be an American manufacturing company and the German firm Ambi (Arthur Mueller), in Johannisthal. The former member is said to possess 49 per cent and the latter 51 per cent of the capital stock and the maintenance of a German majority is assured for 15 years, according to the story. It is further stated that the plant will be organized for a daily production of 200 bodies and that deliveries will be begun in October.

Variety of Subjects for Summer Meeting of S.A.E.

Coming changes and improvements that are likely to be incorporated in automobiles, trucks and motorcoaches within the next few years will be forecast in the subjects discussed at the summer meeting of the Society of Automotive Engineers, to be held at French Lick Springs, Ind., from June 1 to 4.

Exhibits, demonstrations, motion pictures and hundreds of lantern slides will enable those who attend the meeting to visualize the actual application of the principles discussed by the speakers.

Results of tests of automobile riding qualities and of the effects of seat cushions and their springs on riding comfort are to be given and demonstrated by R. W. Brown, of the Firestone Tire and Rubber Co., and W. C. Keys, of the Gabriel Snubber Sales and Service Co.

Reports of the latest findings of several government bureaus are to be presented. What has been found out by a thorough investigation of anti-freeze solutions and compounds is to be told by H. K. Cummings, of the Bureau of Standards. The latest results of test of road impact on trucks and tires that have been in progress in Washington for many months will be shown and explained. New tests for the properties and suitability of motor fuels are to be described and demonstrated by T. S. Sligh, Jr.

Some of the causes of engine wear are to be revealed as the result of findings that have developed recently regarding the relation of crankcase oil contamination to engine wear, as indicated by analyses of hundreds of samples of oil taken from cars operated in a dozen cities in different parts of the country.

Demonstrations are to be made of two-cycle heavy oil engines for automobiles. Methods of testing and indicating the power and speed of high-speed engines will be demonstrated by H. M. Jacklin, of Ohio State University.

The new "hypoid" gear and pinion for rear axle work is to be described by A. L. Stewart and Ernest Wildhaber, of the Gleason Works; and a representative of the Timken Detroit Axle Co. will review the development of the worm drive, which is now about to come into use on passenger cars.

Latest developments in tires and drop-center rims that make tire removal easy without tools are to be recounted by B. J. Lemon, of the U. S. Tire Co.

A phase of engineering that has not been given much consideration is its relation to business. This is to be discussed by a prominent engineering executive.

Personals

EARL CANNON has been appointed hydraulic engineer for the Gogan Machine and Foundry Co., Cleveland, Ohio.

JOHN MARSCH was elected president of the Wisconsin & Michigan Railroad Co. at a recent meeting.

EMIL GATHMANN has been elected president of the Gathmann Engineering Co., of Baltimore.

H. A. SOVERHILL has resigned as vice-president of the Davenport Locomotive Works, of Davenport, Iowa.

FRANCIS A. EMMONS, advertising manager of the Foot Bros. Gear and Machine Co., of Chicago, has been appointed sales manager of the company.

F. S. KNOWLES has been elected president and general manager of the La Salle Tool Co., of La Salle, Ill., manufacturer of twist drill grinders.

GORHAM C. PARKER, formerly with the Oberlin Manufacturing Co., of Oberlin, Ohio, is now sales director of the Furr Auto Signal Corporation, of Ann Arbor, Mich.

A. E. GIBSON has been elected vice-president of the Fulton Foundry and Machine Co., of Cleveland. He was formerly associated with the Wellman-Seaver-Morgan Co.

C. H. WHITING has been appointed Detroit representative for the Van Norman Machine Tool Co., of Springfield, Mass. He was formerly methods engineer for the De'Jon Electric Corporation.

RALPH SIMPSON, for many years associated with the Potter & Johnson Machine Co., of Pawtucket, R. I., has been appointed sales manager for the Leon J. Barrett Co., of Worcester, Mass., manufacturer of the Curtis centrifugal oil extractor.

R. F. FISKE has been appointed sales manager for the R. D. Nuttall Co., of Wilkinsburg, Pa. He was formerly manager of the Philadelphia office of the company, but is now located at the main offices at Pittsburgh.

HENRY J. BAILEY has resigned as vice-president of the Consolidated Machine Tool Corporation of America, Rochester, N. Y., and has become identified with the Delaware Electric and Supply Co., of Wilmington, Del. Mr. Bailey will remain as a director of the Consolidated organization.

H. F. DARBY, JR., for more than 20 years connected with the Cutter Electrical and Manufacturing Co., Philadelphia, and for the past six years sales manager of that organization, has resigned to organize a sales service for electrical and power machinery manufacturers. Mr. Darby states that he is about to visit manufacturing plants throughout the country and expects to establish headquarters in Philadelphia about the first of June.

WALTER O. BRIGGS, president of the Briggs Manufacturing Co., of Detroit, builder of automobile bodies, has become chairman of the board, and John H. French has been elevated to the presidency of the company. Other officers elected were: H. C. Maise, first vice-president; M. L. Briggs, second vice-president; O. Pegau, vice-president in charge of manufacturing; W. F. Connolly, treasurer; H. W. Griffith, secretary; L. A. Lark, assistant secretary and assistant treasurer.

Business Items

The Apex Machine Co., of Dayton, Ohio, has moved into a new plant at 300 Davis Ave., Dayton.

Headed by M. L. Wolfe, prominent in machinery circles in East Tennessee, the Knoxville Tool, Machine and Die Co., 426 Maloney Ave., Knoxville, Tenn., has been incorporated.

The Airkool Spark Plug Corporation, 252 Northwest 29th St., Miami, Fla., has completed an addition to its plant providing about 8,500 sq.ft. of space, equipped with screw machines, lathes, presses and other machinery for the manufacture of spark plugs.

The Federal Press Co. is the new name taken by the company heretofore known as the Loshbough-Beck Press Co., of Elkhart, Ind. The change was made to eliminate confusion in the association of the name Loshbough with a former company. There has been no change in the personnel or management of the new company.

Hall-Will, Inc., has been organized with a plant and offices at Erie, Pa., to manufacture pipe, bolt and nipple threading machinery. Lellie S. Hall, formerly vice-president and general manager of the Williams Tool Corporation, is president and general manager of the company. C. F. Williams is vice-president and Harry W. Sims is secretary and treasurer. Directors include G. C. Hay, J. W. McLeod, C. A. Rice and J. H. Sternberger.

Trade Catalogs

Cements, Refractory. Norton Co., Worcester, Mass. A small 12-page booklet has been published by this company to describe its refractory, Alundum, Crystolon and magnesia cements. Their differences and properties are briefly pointed out.

Compressors, Air. Pennsylvania Pump & Compressor Co., Easton, Pa. Bulletin No. 127 is devoted to the class 3A air compressor driven by a direct-connected synchronous motor. The bulletin describes in detail the equipment for a complete installation.

Furnaces, Heat-Treating. The American Gas Furnace Co., Spring and Lafayette Sts., Elizabeth, N. J., is distributing a reprint of one of its advertisements in the *American Machinist*. The folder shows a view of the heat-treating department of the Timken Roller Bearing Co., Canton, Ohio.

Milling Machines. The Keller Mechanical Engineering Corporation, 70 Washington St., Brooklyn, N. Y., has prepared a description of its type BL tool-room machine. Many photographs show the details of construction and a full explanation is given of the principles of operation and of the range of work for which the machine is intended. The bulletin contains eight, 8½x11-in. pages.

Pumps, Suction. Morris Machine Works, Baldwinsville, N. Y. Bulletin No. 122, containing twenty, 8x10½-in. pages, describes the Morris double-suction pumps having horizontally split casings. The description is full and well organized. Tables show the sizes in which the pump can be had. The catalog is profusely illustrated with photographs of various construction details and of many installations of the pumps.

Pyrometers. The Brown Instrument Co., 4501 Wayne Ave., Philadelphia, Pa. A bulletin has been issued by this company to briefly describe its various models of recording pyrometers. Illustrations are included in the circular.

Reamers. The Wetmore Reamer Co., Milwaukee, Wis., has issued an attractive catalog, No. 26, on Wetmore Adjustable reamers. Each type is illustrated and briefly described, and specification tables are included. The catalog contains twenty-four, 10x8-in. pages, and is bound in a well-executed limp cardboard cover.

Screw Threads. The Eastern Machine Screw Corporation, 20-40 Barclay St., New Haven, Conn., has issued a wall chart based on the specifications for screw threads recommended by the Division of Simplified Practice of the Department of Commerce. It is entitled "Data on the Design and Manufacture of Threaded Parts."

Shelving. David Lupton's Sons Co., Philadelphia, Pa. Catalog No. C-174 is a large and well-illustrated one devoted to Lupton display and storage equipment. Brief descriptions of the various types and views of many installations are included in the bulletin which contains thirty-two 8½x11-in. pages.

Speed Reducers. Boston Gear Works Sales Co., Norfolk Downs, Mass. Folder No. C-126 briefly describes and illustrates the adjustable speed reducer manufactured by this company.

Steel, Nickel. The International Nickel Co., 67 Wall St., New York, N. Y., has published a folder on the applications and uses of nickel steel. A description of the properties and many illustrations are included in the bulletin.

Steels, Alloy. The International Nickel Co., 67 Wall St., New York, N. Y., has prepared an attractive booklet, containing sixteen, 9x12-in. pages, entitled "Paving the Way for Alloy Steels." The design and arrangement of the booklet are unusually artistic. The booklet discusses the advertising of alloy steel and includes several reprints of advertisements used by the company.

Turret Lathes. The Warner & Swasey Co., Cleveland, Ohio, is distributing Book II of its series on modern tooling methods for turret lathes. The booklet contains thirty-four, 6x9-in. pages on chuck work. The material is composed largely of that which appeared in the *American Machinist* during February and March, and which was written by M. E. Lange, production engineer of the company.

The first part of the booklet is devoted to general methods for increasing production and the remainder deals with holding devices and typical layouts to serve as examples of the methods.

A second section on chuck work containing addition examples of chuck tooling and a more detailed description of the chuck tools themselves will be Book III of the series.

The design of Book II conforms to the high standards set by Book I and shows the care that has been taken in its preparation. It is profusely illustrated with paragraphs and line drawings that contribute to the pleasing appearance of the booklet.

Thermometers. The Brown Instrument Co., 4571 Wayne Ave., Philadelphia, Pa., has published Catalog No. 92 on Brown resistance thermometers for indicating, recording and controlling purposes. The descriptions of the various models and their accessories are concise but well illustrated. Views of several installations of complete equipment are given. The catalog is a well-arranged one.

Tools and Wrenches. The Billings & Spencer Co., Hartford, Conn., has issued the 36th edition of its general catalog on drop-forged mechanics' tools. It contains over one hundred and twenty, 7½x10½-in. pages, with brief descriptions, lists of sizes and specifications, and illustrations of the various types.

Many additions to the line of Billings' products are indicated by means of blue pages.

Tramrail Equipment. The Cleveland Electric Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio, is publishing circulars on Cleveland tramrail window-washing systems for industrial plants, as well as on various types of conveying tramrails of both the hand and the power types. The pamphlets are well illustrated and feature photographs of many installations of the equipment.

Welding Apparatus. Burke Electric Co., Erie, Pa. Bulletin No. 133, arranged for loose-leaf filing, describes and illustrates the various types of electric arc-welding equipment manufactured by this company. The descriptions are quite full and show the uses and advantages of each type.

Welding Apparatus. The International Oxygen Co., Newark, N. J., has published a catalog on its "Eyeosee" and "International" welding and cutting equipment. Various types of gages, cutting and welding torches, and other accessories are illustrated and briefly described in the bulletin.

Welding Rod, Brass. Mueller Brass Co., Port Huron, Mich. A circular now being issued by this company lists the properties of various brands of Mueller brass and bronze welding rods.

Calendar of Local Meetings

National Association of Cost Accountants

New York. May 11. Annual election. Automobile Transportation Costs.

Albany. May 12. The Advantages of Mechanical Equipment in the Cost Department.

Worcester. May 13. Annual election.

Philadelphia. May 14. The Training of Supervisory People. Reduction of Cost in Keeping Labor Turnover at a Minimum.

Mohawk Valley. May 17. Plant inspection and visit to a manufacturing plant at Ilion, N. Y. The Company's Cost Methods and the Uses Made of Its Cost Records.

Hartford. May 18. Annual ladies' night for members and their ladies.

Los Angeles. May 18. How a Cost System Can Reduce Costs. Standard Costs Compared with Actual Costs. Accounting machine demonstration.

Twin Cities. May 18. Trucking Cost Problems—Owned vs. Hired Trucks.

Cleveland. May 19. Distribution and Marketing. Rate Setting and Time Study.

Pittsburgh. May 19. Manufacturing Budgets or the Content of a Course in Cost Accounting.

Syracuse. May 19. "Practical Uses of Standard Costs," by Eric A. Camman; Peat, Marwick, Mitchell & Co., New York.

Chicago. May 20. The Relation of Cost Accounting in Industrial Planning.

Milwaukee. May 21. Election of officers. What Are the Functions of the Cost Department from the Executive's Point of View?

San Francisco. May 24. Signs of Progress in Cost Accounting.

Scranton. May 25. "The Pennsylvania Corporation Taxes," by P. A. Kennedy, Pennsylvania Corporation Tax Office.

Boston. May 27. "Cost Accounting vs. Industrial Relations," by Frank J. Dunleavy; The Dunleavy Company.

Buffalo. May 27. Annual election. Financial Statement Analysis. The Use of Graphic Charts for Executives.

Detroit. May 27. Problems in Overhead Distribution.

American Society for Steel Treating

Hartford. June. Spring sectional meeting.

Society of Automotive Engineers

Pennsylvania Section. May 11. "Problems Encountered in the Design and Construction of Universal Joints," by C. W. Spicer.

Southern California Section. May 14. "Improvements Needed in Motor Vehicles to Render Them More Efficient, and What I Consider the Most Recent Great Improvement," by F. D. Howell, Eugene Power, P. H. Decker, Wm. H. Fairbanks, R. W. Stewart, Donald W. Douglas and J. J. Canavan.

Chicago Section. May 17. "Gasoline Substitutes from Coal," by A. C. Fieldner.

Buffalo Section. May 18. "Coincidental Locks," by C. B. Veal.

Detroit Section. May 20. "Coincidental Locks," by C. B. Veal.

Metropolitan Section. May 20.

American Society of Mechanical Engineers

New England Meeting. May 3 to 6. Providence, R. I. Chairman of program committee, Luther D. Burlingame.

Forthcoming Meetings

American Gear Manufacturers' Association. Tenth annual meeting, Book-Cadillac Hotel, Detroit, May 13, 14 and 15. T. W. Owen, secretary, 2443 Prospect Ave., Cleveland, Ohio.

American Supply and Machinery Manufacturers' Association. Annual convention, Hotel Statler, St. Louis, week of May 17. F. D. Mitchell, secretary, 1819 Broadway, New York.

American Iron and Steel Institute. Spring meeting, Hotel Commodore, New York, May 21. E. S. Clarke, secretary, 40 Rector St., New York.

Society of Automotive Engineers. Summer meeting, French Lick Springs, Indiana, June 1 to 4. John Warner, manager of meetings, S. A. E., 29 West 39th St., New York City.

Iron and Steel Exposition. Annual exhibit of fuel, electricity, machinery and safety under the auspices of the American Society for Steel Treating, Hotel Sherman, Chicago, June 7, 8, 9 and 10. Secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

National Association of Purchasing Agents. Eleventh annual convention and exposition, Ambassador Hotel and Auditorium, Los Angeles, Calif., June 9 to 12. W. L. Chandler, secretary, Woolworth Bldg., New York.

American Railway Association. Annual meeting of the Mechanical Division (Master Car Builders and Master Mechanics), Atlantic City, N. J., June 9 to 16. V. R. Hawthorne, secretary, 431 So. Dearborn St., Chicago.

Railway Supply Manufacturers' Association. Annual convention and exhibit in conjunction with Division V, Mechanical, of the American Railway Association, Young's Million Dollar Pier, Atlantic City, June 9 to 16. J. D. Conway, secretary, 1841 Oliver Bldg., Pittsburgh.

Society of Industrial Engineers. Thirteenth national convention, Bellevue-Stratford Hotel, Philadelphia, June 16, 17 and 18. Executive secretary, George C. Dent, 608 S. Dearborn St., Chicago.

American Society for Testing Materials. Haddon Hall Hotel, Atlantic City, N. J., June 21 to 25. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia.

American Society of Mechanical Engineers. Spring meeting, Palace Hotel, San Francisco, Calif., June 28 to July 1. Chairman of convention, Warren H. McBride, the California and Hawaiian Sugar Refining Co., 215 Market St., San Francisco.

American Railway Tool Foremen's Association. Annual convention, Hotel Sherman, Chicago, Sept. 1, 2 and 3. G. G. Macina, secretary, 11402 Calumet Ave., Chicago.

American Railway Tool Foremen's Supply Association. Annual exhibit in connection with the annual convention of the American Railway Tool Foremen's Association, Chicago, Sept. 1, 2 and 3.

Machine Tool Exhibit. Sixth annual exhibition of machine tools at the Mason Laboratory, Yale University, under the auspices of the New Haven Section, A.S.M.E., the mechanical engineering department of the Sheffield Scientific School, and the New Haven Chamber of Commerce, Sept. 7 to 10. Administrative office, New Haven Machine Tool Exhibit, 400 Temple St., New Haven, Conn.

American Society for Steel Treating. Eighth national steel and machine tool exposition, Municipal Pier, Chicago, Sept. 20 to 24. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

American Foundrymen's Association. Second international foundrymen's congress, Detroit, Sept. 27 to Oct. 1, under the auspices of the American Foundrymen's Association. R. E. Kennedy, secretary, 909 W. California St., Urbana, Ill.

The Weekly Price Guide

Rise and Fall of the Market

IRON buying continues slow; prices, however, remain steady. Steel demand is active in plates, particularly for ship building; the minimum mill quotation now being $1.90 per 100 lb. as against $1.80 on April 1. Requirements are a trifle lighter than a week ago in steel structurals, automotive and railway materials. No decline is noted in buying for agricultural implement manufacture. The Pittsburgh mill base on galvanized steel sheets dropped 10c. per 100 lb. during the past week. Fluctuations in the non-ferrous metals' market have not materially affected the fabricated products. Scrap copper and lead, however, are cheaper. Furnace coke is off 10c. and foundry, 25c. per ton from the April 23 level at Connellsville. Linseed oil rose 0.2c. at Chicago and 0.4c. per lb. at New York during the week.

(All prices as of April 30)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$24.05
Northern Basic	24.27
Southern Ohio No. 2	24.27
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	28.37
BIRMINGHAM	
No. 2 Foundry	22.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	23 76
Virginia No. 2	29.17
Basic	22.76
CHICAGO	
No. 2 Foundry local	23.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	26.55
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	21.27
Basic	21.27
Bessemer	21.27

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	5.00@5.25
Cleveland	5.00@5.25
Cincinnati	5.00@5.50
New York	5.25@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.50	3.89	3.25	3.50
No. 12	2.55	3.94	3.30	3.55
No. 14	2.60	3.99	3.35	3.60
No. 16	2.70	4.09	3.45	3.70
Black				
Nos. 18 to 20	3.05@3.15	4.30	3.90	3.90
Nos. 22 to 24	3.10@3.20	4.35	3.95	3.95
Nos. 26 and 27	3.15@3.25	4.40	4.00	4.00
No. 28	3.25@3.35	4.50	4.10	4.10
Galvanized				
No. 10	3.50@3.60	4.65	4.25	4.25
Nos. 12 to 14	3.60@3.70	4.75	4.35	4.35
No. 16	3.75@3.85	4.90	4.50	4.50
Nos. 18 to 20	3.90@4.00	5.05	4.65	4.65
Nos. 22 to 24	4.05@4.15	5.20	4.85	4.80
Nos. 26 and 27	4.20@4.30	5.35	5.10	4.95
No. 28	4.50@4.60	5.65	5.25	5.25

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	58%	45%
2½ to 6 in. steel lap welded	48%	35%	53½%	40½%	55%	42%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameter in Inches — External	Diameter in Inches — Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at warehouse in lots of less than 100 ft.:

Thickness — Decimal	B.W.G. and Fractions	Outside Diameter in Inches — ¼	⅜	½	⅝	1	1⅛	1¼
		Price per Foot						
.035"	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049"	18	.17	.18	.19	.20	.21	.23	.25
.065"	16	.19	.20	.21	.22	.23	.25	.27
.083"	14	.20	.22	.23	.24	.25	.27	.29
.095"	13	.21	.23	.25	.26	.27	.29	.31
.109"	12	.22	.24	.26	.27	.28	.30	.32
.120" or .125"	11	.23	.25	.27	.28	.29	.31	.33
.134"	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Spring steel (light) (base)*	7.00	6.00@7.50	4.65†
Spring steel (heavier)	4.00	....	4.00
Coppered Bessemer rods (base)	6.05	6.00	6.20
Hoop steel	4.49	3.65	4.15
Cold rolled strip steel	6.25	6.35	6.25
Floor plates	5.25	5.30	5.00
Cold drawn shafting or screw	4.00	3.90	3.60
Cold drawn flats, squares	4.50	4.40	4.10
Structural shapes (base)	3.34	3.10	3.10
Soft steel bars (base)	3.24	3.00	3.00
Soft steel bar shapes (base)	3.24	3.00	3.10
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.20	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	60@65%	55%	50%

Electric welding wire, New York, ⅜", 8.25c.; ½", 7.85c.; ⅝" to ¼", 7.35c. per lb. *Flat, ⅛"@¼"-in. thick. †F.o.b. cars.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			15.25
Tin, 5-ton lots, New York			65.00
Lead (up to carlots) E. St. Louis	7.60	New York	8.50
Zinc (up to carlots) E. St. Louis	6.90	New York	7.87½

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	17.00	22.50	26.00
Copper sheets, base	22.50	22.50	22.50
Copper wire, base	19.25	16.50	16.00
Copper bars, base	22.12½	22.12½	21.87½@22.12½
Copper tubing, base	24.25	24.25	24.25
Brass sheets, base	18.87½	18.87½	18.87½
Brass tubing, base	23.50	23.50	23.50
Brass rods, base	16.62½	16.62½	16.62½
Brass wire, base	19.37½	19.37½	19.37½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	27.00	27.00	27.02
Zinc sheets (casks)	12.00	12.60@12.95	12.27
Solder (½ and ½), (case lots)	40.12½	42.00	38½@42½

Babbitt metal, delivered, New York, cents per lb.:

Genuine, highest grade	81.62½
Commercial genuine, intermediate grade	56.00
Anti-friction metal, general service	31.50
No. 4 babbitt (f.o.b.)	14.00

Nickel, f.o.b. refinery, cents per lb.:

Ingots	31 00	Electrolytic	38.00
Shot			32.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00
Cold rolled sheets (base)			50 00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	11.75@12.25	11.25	10.75@11.25
Copper, heavy, and wire	11.00@11.75	11.50	10.25@10.75
Copper, light, and bottoms	9.50@10.00	10.00	9.50@10.00
Heavy lead	6 87½@ 7.12½	7.50	6.25@ 6.75
Tea lead	4.75@ 5.00	5.00	5.00@ 5.50
Brass, heavy, yellow	7.25@ 7.50	7.25	7.00@ 7.50
Brass, heavy, red	9.50@ 9.75	9.50	8.25@ 8.75
Brass, light	6.00@ 6.25	6.00	6.25@ 6.75
No. 1 yellow rod turnings	8.25@ 8.50	8.00	7.50@ 8.00
Zinc	4.50@ 4.75	4.75	4.00@ 4.50

TIN PLATES—American Charcoal—Bright—Per box

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$12.10	$11.45	$11.50
"A" Grade:				
IC,	14x20	9.70	9.40	9.50
Coke Plates—Primes—Per box				
100-lb.,	14x20	6.45	6.10	7.00
Terne Plates—Small lots, 8-lb. Coating—Per box				
IC,	14x20	7.75@8.00	6.95	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.13@0.17½	$0.18	$0.15@0.20
Cotton waste, colored, per lb.	.10@ .14	.17	.12@.17
Wiping cloths, washed white, per lb	.18	36.00 per M	.16
Sal soda, per 100 lb. keg	2.05	2.25	2.75*
Roll sulphur, per 100 lb	3.60†	3.35	4.25‡
Linseed oil, per gal., 5 bbl. lots	.86½	.96	.87
Lard cutting oil, 25% lard, per gal.	.55	.50	48
Machine lubricant, medium-bodied (55 gal. metal bbl.), per gal.	.35	.35	.29
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40–5%	40–5%	40–5%
Heavy grade	30–10%	30–10%	30–10%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

*In 175 lb. kegs. † Per 150 lb. lot. ‡In 425 lb. barrels

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0 0324
Cold drawn shafting	per lb.	04	.04	.0415
Brass rods	per lb	.1662½	.1687½	.1587½
Solder (½ and ½)	per lb.	.4012½	.4012½	.37
Cotton waste	per lb.	.13@ 17½	.13@.17½	15@22
Washers, cast iron (½ in.)	per 100 lb.	7 00	7 00	7.00
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3 55	3.55	3.38
Lard cutting oil	per gal.	55	.55	.60
Machine oil	per gal.	35	35	33
Belting, leather, medium	off list	40–5%	40–5%	30–10%
Machine bolts up to 1x30 in.	off list	40%	40%	40%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.56	$5.84	$5.65
Emery paper	10.71	11.00	10.71
Emery cloth	29.48	31.12	29.48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.45	1.49
Cloth	3.55	3.55	3.20
Fire clay, per 100 lb. bag		.60	.75
Coke, prompt furnace, Connellsville	per net ton	3 00@ 3.15	
Coke, prompt foundry, Connellsville	per net ton	4.25@ 4.75	
White lead, dry or in oil	100 lb. kegs	New York, 15.25	
Red lead, dry	100 lb. kegs	New York, 15.25	
Red lead, in oil	100 lb. kegs	New York, 16.75	

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1¼ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{5}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1½x¼-in., $1.00 per 100. List plus 35% at New York warehouses.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ¼x¼-in., 2c. each. Discount 70% for $\frac{5}{16}$-in and smaller and 65% for ⅜-in. and larger.
Case hardened ¼x¼-in., 6c. each, less 50%

Rivets, button heads, ⅜-in., ½-in., 1-in. diam. x2$\frac{1}{16}$-in. to 4⅛-in. $5.00* per 100 lb. at New York warehouses; cone heads same sizes, $5.20* per 100 lb. Rivets, $\frac{7}{16}$x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1½ to 2-in. long, all diameters, 25c.; ⅝-in. dia., 35c.; ¾-in. dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

Washers, cast iron, ½-in., $7.00* per 100 lb. at New York warehouses: ⅝-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Ala., Birmingham—Birmingham Aluminum & Novelty Co., 3916 34th St.—stamping and moulding equipment.

Calif., Alameda—Bd. of Education, W. G. Paden, Secy., will receive bids until May 11 for machine shop equipment for high school department.

Mass., Somerville (Boston P. O.)—Winter Hill Realty Co. Inc., 333 Broadway—miscellaneous tools and equipment for proposed 2 story repair and service garage. Estimated cost $100,000.

N. Y., Brooklyn — Mutual Electric & Hardware Co., 28 Verandah Place, R. A. Pinner, Purch. Agt.—48 to 60 in. single head planer, No. 2 universal milling machine, power squaring shear to cut ⅜ in. metal, triple geared lathe and punch pres..

O., Columbus—Lambert Art Metal Inc., 182 Lorain Ave., B. C. Lambert, Pres. & Mgr. (metal doors and specialties)—3 heavy rolling machines.

Pa., Philadelphia—Pennsylvania R.R. Co., Broad St. Station, S. Porcher, Gen. Purch. Agt.—drill grinder, lathe, milling machine and grinder for Altoona shops.

W. Va., Logan—Guyan Machine Shops—boring mill, mica cutting machine, punch and shear, also wheel lathe for turning mine locomotive tires up to 36 in. diameter, gage 32 to 48 in.

Wis., Platteville—Russell Foundry Co.—foundry equipment for proposed 1 story, 40 x 110 ft. foundry. Estimated cost $25,000.

Wis., West Allis—Bd. of Industrial Education, S. Moore, Pres.—machinery for shop for proposed 3 story vocational school. Estimated cost $100,000 to $150,000.

N. B., Sussex—Wallace Mfg. Co. Ltd., H. W. Wallace, Purch. Agt.—(mill machinery and threshing machines, etc.)—complete machine shop equipment.

Que., Farnham—The American Wringer Co. Inc. (wringers, etc.)—complete equipment for proposed new plant.

Que., Montreal—Herbert Garage, 415 Ontario St. E., A. Herbert, Purch. Agt.—bench lathe and miscellaneous tools for repair shop.

Que., Montreal—Montreal Tramway Co., Craig St. W.—general equipment and miscellaneous tools for large addition to St. Henry garage.

Opportunities for Future Business

Ala., Birmingham—McWane Cast Iron Pipe Co., W. McWane, Secy., 27th Ave. N., plans the construction of addition to plant including foundry and machinery departments.

Calif., Burbank—First National Production Corp., R. A. Rowland, Gen. Mgr. 383 Madison Ave., New York, N. Y., awarded contract for the design and construction of a moving picture studio including metal shop, foundry, garage, etc. to The Austin Co., 769 East Washington St., Los Angeles, Calif. Estimated cost $2,000,000.

Calif., Los Angeles — Water & Power Commission, 207 South Broadway, will build a 5 story, 61 x 150 ft. addition to garage. Estimated cost $200,000. L. L. Smith, 833 South Spring St., Archt.

Calif., Los Angeles—M. Winter, c/o N. W. Alpaugh, 2404 West 7th St., awarded contract for the construction of a 13 story garage and office building on Spring St. Estimated cost $500,000.

Conn., Bristol—E. Ingraham Co., 392 North Main St., clock manufacturers, awarded contract for the construction of a 5 story, 80 x 125 ft. warehouse and additions to buffing, plating and case department, etc. Estimated cost $200,000. Noted Apr. 1.

Fla., Tampa—Atlantic Coast Line R.R. awarded contract for the design and construction of a locomotive repair shop at Uceta near here to Dwight P. Robinson & Co. Inc., 125 East 46th St., New York, N. Y. Estimated cost $1,000,000. J. E. Willoughby, Wilmington, N. C., Ch. Engr.

Ill., Decatur—Wabash Ry. Co., Exchange Bldg., St. Louis, Mo., awarded contract for the construction of a repair shop here. Estimated cost $1,000,000. R. H. Howard, Ch. Engr.

Ill., Peoria — South Side Foundry Co., 2900 South Washington St., awarded contract for the construction of a 2 story, 60 x 80 ft. iron foundry. Estimated cost $20,000. Noted Apr. 29.

Mass., Brighton (Boston P. O.)—Warren Engineering Co., 50 Terminal St., Boston, Engr., is receiving bids for the construction of a 2 story garage here for Mack Motor Truck Co., 75 North Beacon St. Estimated cost $150,000.

Mass., Brookline (Boston P. O.)—Henderson & Ross, 209 Washington St., Boston, is having preliminary plans prepared for the construction of a 3 story garage at John, Pleasant and Waldo Sts. here. Estimated cost $500,000. H. F. Kellogg, 278 Stuart St., Boston, Archt.

Mass., Norfolk Downs (Boston P. O.)—Norfolk Iron Works, awarded contract for the construction of a 1 story, 65 x 150 ft. factory. Estimated cost $40,000. Noted Apr. 1.

Mass., Readville (Boston P. O.)—The New York, New Haven & Hartford R.R. Co., is receiving bids for the construction of a 1 story locomotive repair shop, etc. E. Gagel, New Haven, Conn., Ch. Engr.

Mass., Springfield—Westinghouse Electric & Mfg. Co., Page Blvd., is receiving bids for the construction of a 2 story, 45 x 300 ft. office and manufacturing building. Estimated cost $159,000. B. H. Prock, 119 Federal St., Pittsburgh, Pa., Archt.

Mich., Flint—A. C. Spark Plug Co., awarded contract for the construction of a 1 story, 72 x 252 ft. additional factory unit. Estimated cost $80,000.

Mo., Kansas City — Progressive Brass Mfg. Co., 1711 Cherry St., awarded contract for the construction of a 1 story, 50 x 70 ft. foundry. Estimated cost $25,000.

Mo., St. Louis—Hemp & Co., 1939 South Vandeventer Ave., manufacturers of furnaces, awarded contract for the construction of a 2 story, 80 x 145 ft. factory at 1945 South Vandeventer Ave. Estimated cost $40,000.

N. J., Camden—Bridge Plaza Garage Co., c/o Ballinger Co., 12th and Chestnut Sts., Philadelphia, Pa., will soon award contract for the construction of a 5 story, 186 x 201 ft. garage and stores building at 7th and Linden Sts., here.

N. J., Roselle (Elizabeth P. O.)—Rapid Addressing Machine Co., 46 West 43rd St., New York, N. Y., awarded contract for the construction of a 1 story, 200 x 321 ft. plant here. Noted Apr. 22.

N. Y., Arcade—O'Dell & Eddy, manufacturers of shoe lasts, plans to rebuild factory recently destroyed by fire. Estimated cost $100,000.

N. C. Gastonia—Ferguson Gear Co., has work under way on the construction of additional manufacturing buildings to increase the capacity of its plant.

O., Canton—Ohio Power Co., 301 Cleveland Ave. S. W., will soon receive bids for the construction of a 2 story garage and storage building at Savannah Ave. and Second St. S. W. Estimated cost $150,000.

O., Canton—United Alloy Steel Corp., 8th St. N. E. plans the construction of additions to mill. Estimated cost $300,000.

O., Cleveland—The American Steel & Wire Co., Rockefeller Bldg., awarded contract for the construction of a 2 story, 95 x 296 ft. factory at 810 Broadway. Estimated cost $175,000.

O., Cleveland—Barnes Motor Co., (Dodge Bros. Agency, c/o W. Pitt Barnes, Pres., 1938 East 21st St.), has acquired a site and plans the construction of a 3 or 4 story, 100 x 376 ft. sales and service station at 2830 Prospect Ave. Estimated cost $300,000. Architect not selected.

O., Cleveland—George S. Rider Co., Century Bldg., Archt., is receiving bids for the construction of a 1 story, 90 x 120 ft. addition to factory on East 49th St. for Cleveland Wire Spring Co., J. W. Campbell, Secy. & Treas., 1281 East 38th St. Estimated cost $50,000.

O., Cleveland—Sawyer Gear & Mfg. Co., W. R. Sawyer, Pres., 5122 St. Clair Ave., is receiving bids for the construction of a 2 story, 100 x 100 ft. addition to factory. Estimated cost $50,000. Private plans.

O., Columbus — Chas. Zimmerman Sons Co., 269 East Broad St., awarded contract for the construction of a 2 story addition to garage at Third and Chestnut Sts. Estimated cost $60,000.

O., Marion—Fairfield Engineering Co., H. B. Walker, Pres., manufacturers of conveying and other machinery, will soon receive bids for the construction of a 1 story factory and office on Benhart St. Estimated cost $40,000.

O., Springfield—Mast Foos & Co., Main and Isabella Sts., manufacturers of lawn mowers and iron pumps, awarded contract for the construction of a 1 story, 100 x 210 ft. factory on Isabella St. $40,000.

Pa., Bristol—Superior Zinc Corp., c/o H. J. Maroney, Franklin Trust Bldg., Philadelphia, has acquired a 7 acre site and plans a foundry and metal smelting works here.

Pa., Germantown—Louis H. Cahan & Son Inc., Bankers Trust Bldg., Philadelphia, had plans prepared for the construction of a 4 story, 90 x 170 ft. repair and service garage here. Estimated cost including equipment $200,000. J. Meigs, 1001 Chestnut St., Phila., Archt.

Pa., Philadelphia—Allegheny Wagon & Truck Co., 1737 North Front St., plans to rebuild portion of plant recently destroyed by fire. Estimated cost $17,000.

Pa., Philadelphia — F. J. Ryan & Co., Wesley Bldg., awarded contract for the construction of an office building and shop for manufacture and testing of burners and automatic combustion and temperature control device, also standard furnace equipment at Hunting Park and Wissahickon Ave. Complete testing laboratory will be installed.

Wis., Milwaukee—Seaman Body Corp., 1732 Richards St., awarded contract for the construction of a 5 story, 100 x 172 ft. factory. Noted Apr. 22.

Wis., Racine—Modine Mfg. Co., 17th and Racine Sts., manufacturer of heating specialties, awarded contract for the construction of a 1 story 80 x 140 and 110 x 170 ft. addition to factory on 17th St. Estimated cost $50,000.

Wis., Two Rivers—Hamilton Mfg. Co., manufacturers of steel and wood furniture for printing houses, etc., awarded contract for the construction of a 5 story, 120 x 130 ft. and a 1 story, 120 x 150 ft. factory buildings. Noted Apr. 22.